JOURNAL OF DAIRY SCIENCE

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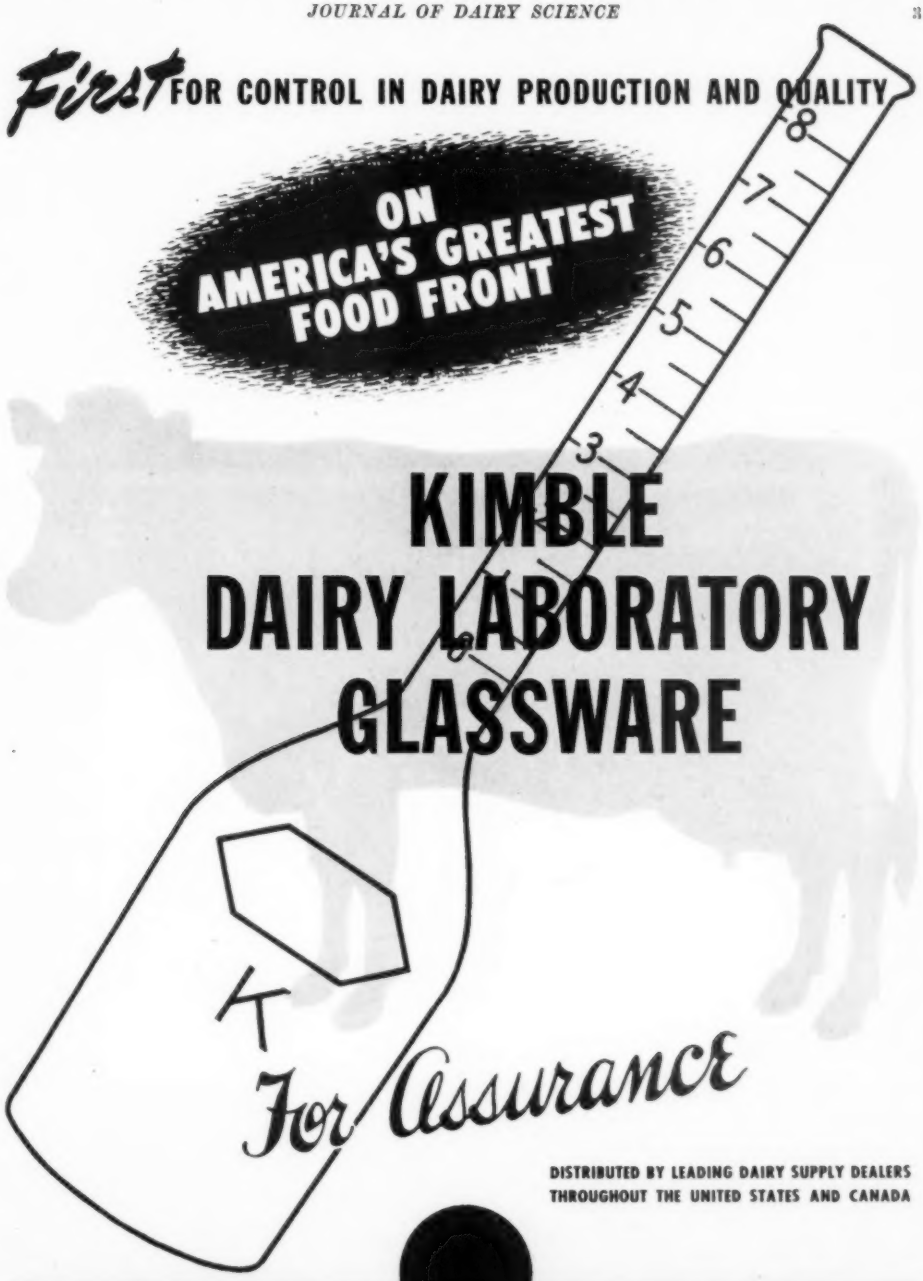

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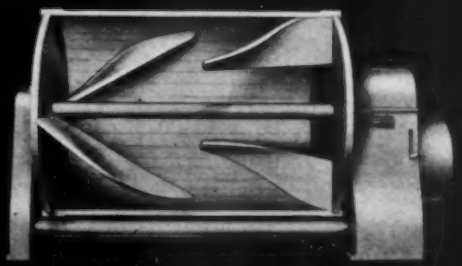

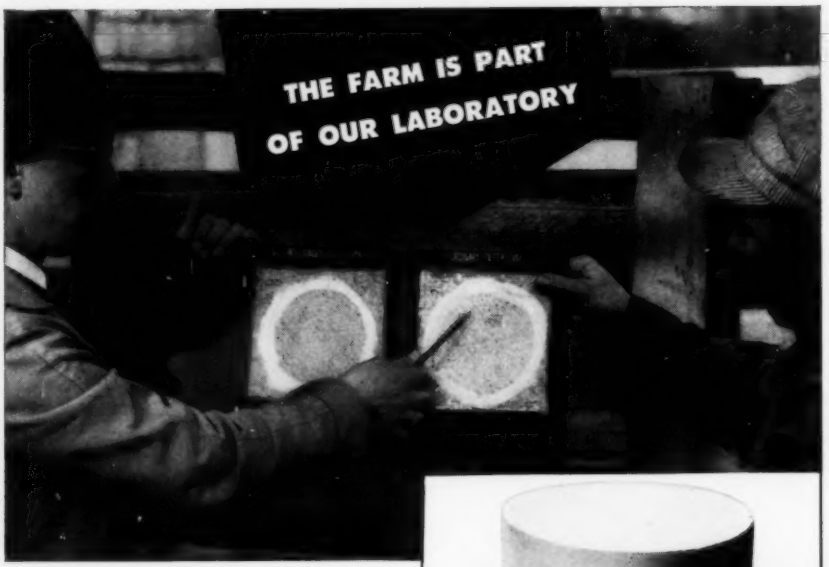

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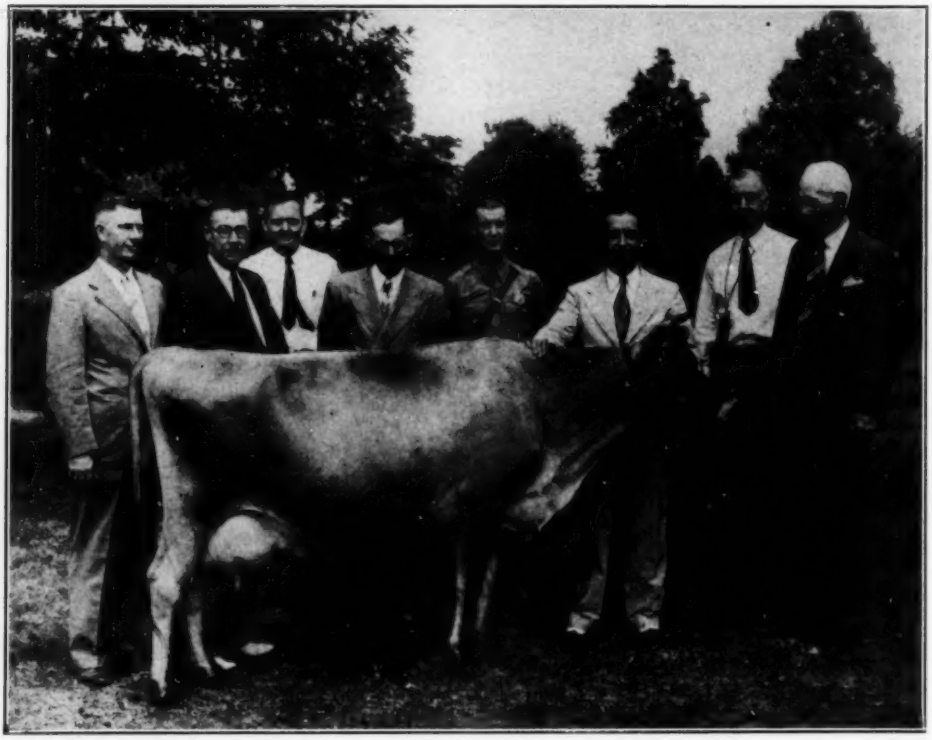

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JOURNAL OF DAIRY SCIENCE

VOLUME XXVII AUGUST, 1944 NUMBER 8

PAPERS PRESENTED AT THE ANNUAL MEETING

SYMPOSIA PAPERS

I. RELATION OF BODY SIZE TO MILK YIELD

A. The Energy-Size Basis of Measuring Milk Yield. W. L. GAINES, *University of Illinois, Urbana, Ill.*

This paper presents some material bearing on the validity of using FCM_8/W_1 as a criterion of dairy development or lactational drive in dairy cows and goats. FCM_8 is milk-energy yield in pounds four per cent milk per day for the first eight months (243 days) of lactation and W_1 is live weight of the cow or doe within 31 days after parturition for the same lactation—FCM_8/W_1 to be measured for each lactation of each cow or doe.

It is shown that FCM_8 is practically unaffected by age independent of W_1. On the other hand, FCM_8 is profoundly affected by W_1 independent of age. Ignoring age FCM_8 tends to be proportional to W_1. Direct test shows that FCM_8/W_1 is independent of age, hence age corrections are eliminated. Direct test shows also that disregarding age FCM_8/W_1 is independent of W_1. These statements apply to dairy cows and does separately, not both together.

In the data presented there appears to be a ceiling for FCM_8/W_1 at about 55 in cows and 110 in goats; also, average FCM_8/W_1 is about twice as high in goats as in cows. That is, with respect to FCM_8/W_1 or metabolic intensity: cows are *like cows;* goats are *like* goats; cows and goats are *different.*

A breeding philosophy: A, breed for size, criterion W_1 (large or small as desired); B, breed for milk composition, criterion fat percentage (high or low as desired); C, breed for lactational drive, criterion FCM_8/W_1 (high as feasible). A, B and C are mutually independent in inheritance. The main thought is to bring dairy development into sharp focus through the quantitative measure FCM_8/W_1.

A tentative standard of excellence in the progeny test of a bull: 1000 $FCM_8/W_1 = 40$ as an average of his daughters; as a plurality of daughter lactations becomes available, variance between daughters is not substantially greater than that within daughters (or intraclass correlation = 0). The first indicates a high level of dairy development, the second indicates homogeneity.

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To estimate gross efficiency ($100 \times$ milk calories/digestible feed calories) the following formulas are indicated:

Cows, 62.5 $(1000\ FCM_s/W_1)/(80/3+1000\ FCM_s/W_1)$

Does, 62.5 $(1000\ FCM_s/W_1)/(160/3+1000\ FCM_s/W_1)$

Two serious objections to gross efficiency are: it is subject to a large error of estimate; it largely obliterates differences between individuals, particularly at high levels of FCM_s/W_1.

B. The Significance of Body Size in the Economy of Milk Production.* SAMUEL BRODY, *Department of Dairy Husbandry, University of Missouri, Columbia, Mo.*

Body size affects the economy of milk production. This fact is generally known, but it is confused by associated factors which we should like to clarify.

1. *"Dairy merit": definition.*[1] One reason for the confusion surrounding the effect of body size on the economy of milk production is lack of clear-cut definitions. The designation "dairy merit" is related in most minds to the economy of milk production, but the relation is not clear; it means different things to different men. Let us, therefore, define it sharply by saying that "dairy merit" represents the biologic efficiency of milk production as measured by the percentage of consumed TDN energy which is converted into milk (FCM) energy. The ceiling of "dairy merit" is 50 per cent; not over $\frac{1}{2}$ or 50 per cent of the consumed TDN may be recovered as milk energy. (The other 50 per cent of the consumed TDN is expended for maintenance and related processes.) The dairy merit of "good" dairy animals is about 25 per cent, that is, they convert $\frac{1}{4}$ or 25 per cent of the TDN energy into milk energy; the dairy merit of "superior" animals is about 33 per cent, that is they convert $\frac{1}{3}$ or 33 per cent of the consumed TDN energy into milk energy.

2. *Body size and dairy merit.* Dairy merit appears to be[1] independent of body size *as such*. Rats, dairy goats, and dairy cattle of all sizes may convert up to about 50 per cent of the ingested TDN energy into milk energy.

3. *Body size and monetary profit of milk production.* If 1600-lb. and 800-lb. cows are in the same dairy merit class, both, for example, converting 30 per cent of the consumed TDN energy into milk energy, and if other conditions are equal, the profit on the milk produced by the 1600-lb. cows will be much greater than on the 800-lb. cows. This is because the labor cost of milking, feeding, cleaning, housing, bookkeeping, etc., is nearly half as much for one 1600-lb. cow as for two equally efficient 800-lb. cows.

This may be illustrated by a more specific numerical example. Suppose that it is desired to produce 1000 lb. FCM daily at 30 per cent efficiency.

* Contribution from the Dept. of Dairy Husbandry, Mo. Agr. Exp. Station Journal Series No. 948.

[1] Mo. Agr. Exp. Sta. Res. Bull. 366, 1943.

By definition of "efficiency" (ratio of milk energy produced to TDN energy consumed), the same amount of TDN, namely,[1] 625 lb., will be consumed to produce this 1000 lb. FCM regardless of the size of the animals. But the number of animals required to produce 1000 lb. FCM per day at 30 per cent efficiency will differ with their size; by our method of computation[1] (FCM yield varies with $W^{0.73}$) it will require fifty-three 700-lb. cows but only twenty-six 1700-lb. cows to produce the 1000 lb. FCM at 30 per cent efficiency. By Gaines' method of computation (FCM yield varies directly with $W^{1.0}$) the difference would be still greater, it would require twice as many 800-lb. cows as 1600-lb. cows to produce 1000 lb. FCM. Since it requires about twice as many stanchions and twice as much labor to handle 53 than 26 cows, the overhead costs (housing, milking, labor, and so on) will be roughly one-half and the profit correspondingly greater in producing the milk with the 1700-lb. than with the 700-lb. cows of *equal dairy merit*. In other words, a given number of large animals constitute a larger business with greater profits than small animals of the *same dairy merit*.

It was shown[1] by a typical numerical example, involving payment for labor, management, and housing, and when *all other conditions are equal*, that the profit on 1400-lb. cows (30 of which are required to produce 1000 lb. FCM at 30 per cent efficiency) is about 50 per cent greater than on 900-lb. cows (42 of which are required to produce FCM at 30 per cent efficiency). Needless to say that "all other conditions" are never equal. There are differences in market demand and in price; in topography and climate; in ability to graze on rolling country and ability to withstand heat and drought; in clumsiness of larger animals; in greater efficiency of smaller animals as result, not of body size *as such*, but because of the more intensive selection that has been practiced on the smaller animals, and so on, which may nullify, in part, the above generalization concerning the greater profitableness of large animals under a given set of conditions. This, then, is in the nature of a general rule, and like other general rules has many exceptions. The importance of these exceptions to this general rule will be reduced in proportion to the increase in equitable standardization of milk quality, standardization in feeding, management, and housing conditions, and standardization in selection and breeding on the basis of dairy merit (rather than on the basis of absolute milk yield, which is ambiguous because of its dependence on body size as well as on dairy merit).

C. Body Size and Lactation Rate. MAX KLEIBER, *Division of Animal Husbandry, College of Agriculture, University of California, Davis, Calif.*

The influence of age on lactation rate can be determined when the effect of body size is derived independently as on the basis of the theory that lactation capacity is proportional to the metabolic body size ($\frac{3}{4}$ power of body weight) of the cows.

The effect of body size on lactation rate cannot be calculated from records within one herd because; (1) the variability of lactation rate, aside from influences of size, ranges from ± 10 to ± 20 per cent of the mean rate even in well-bred herds kept under uniform conditions, and (2) size differences in those herds are as a rule relatively small. The unreliability of results from a recent attempt to calculate size effects on lactation rates within a herd is demonstrated, and a table is given showing the number of cows necessary to distinguish significantly between production rate per unit weight and production rate per unit of metabolic body size.

A table is supplied in which metabolic body size can be read directly when body weight in pounds is given.

Lactation rate per unit of metabolic body size is a sound basis for the calculation of age effects on lactation rate.

The average daily milk production during a 10-month period, expressed as milk energy, and divided by the mean metabolic body size, is suggested as an important result in summaries of production records. When the cows have been kept under *quasi* ideal conditions such a result may be known as relative lactation capacity, expressing quantitatively the inherent ability of cows for milk production and thus useful as a major criterion for breeding dairy cattle.

II. POSTWAR PROBLEMS OF DAIRYING

A. Post-War Problems of Dairying. ERNEST L. ANTHONY, *Dean of Agriculture, Michigan State College, East Lansing, Mich.*

It is already certain that our agricultural colleges will bear much of the brunt of the post-war thinking and planning as it will effect the policies and changes in the Agriculture of the United States at the close of the war. In nearly every agricultural college in the United States may be found, today, faculty committees busy at this task. There is some tendency in the public mind to belittle post-war planning efforts on the basis that the first job is to win the war. No one will disagree that the first objective of all of us is to win and stop this needless war as soon as possible, but to so win the war and lose the fullest benefits of the first years of peace by unpreparedness is foolish indeed.

Post-War Planning Should Become Post-War Preparedness. It is certain that American Agriculture will, as it did following World War No. I, feel the full effect of production to the peace time demands of a war-weary world.

The dairy industry stands today in the front rank of all American farm products in its war role. This industry, thus, has been called upon to expand to the utmost. It stands today at the peak of its production and demands.

To visualize the future which confronts the dairy industry, I feel several things must be given careful consideration. I have listed them as they appear important to me. Undoubtedly many others should be discussed.

1. *What will be the future effect of the widespread recognition of dairy products as essential in good nutrition?*

Today, while prices are good, the industry should use a large percentage of its price gains to more fully educate all the public to the continuing place which dairy products have in a rational adequate diet program for the nation.

2. *What about the post-war competition of other foods?*

The dairy industry is in for keen competition. This competition will be from within and from without.

3. *What about our consumer relation in the post-war period?*

The dairy industry, in its rapid growth, has been so busy just producing more and more that it has paid but little attention to its consumers.

The future security of its present importance depends upon a loyal satisfied consuming public. *It does not have it now.*

4. *Will the dairy industry face a lower price structure?*

The greatest inflation in the industry at present is in cattle prices. The future of pure bred cattle is at stake in the present activity.

5. *What about Research in the Dairy Industry?*

No other industry has benefited more from the results of fundamental and practical research than has the dairy industry. On the other hand, as an industry it has done the least in its own behalf.

B. Is Dairy Expansion to Continue? EARL WEAVER, *Michigan State College, East Lansing, Mich.*

Certain data relating to dairy production, prices and income in the United States for the 34-year period 1910 to 1943 inclusive are presented. These data attest that dairy production in this country has shown a quite consistent increase. The average annual total milk production in the United States for the 34-year period has been 90,644,000,000 pounds. In 1910 the production was only 72 per cent of this average; it increased to the peak of 132 per cent in 1942.

But certain facts here are commonly overlooked. In the 34-year period the incline in production has been interrupted on only three occasions. In a war period, which is accompanied by general agricultural prosperity, relative interest in dairy production subsides. The curve flattened in the years of World War I. Production also dropped from 1942 to 1943 in spite of enormous pressure for increased milk production during the latter year. Even greater pressure is being exerted in 1944. Approximately a million dollars a day in incentive payments to dairy producers have been spent since last October, but expected production this year will not change greatly from that of 1943 and will be less than 1942.

The third interruption in the inclining curve was in 1934 and was due to the drouth that year with the extreme shortage of feed and the consequent slaughter of cows.

Data pertaining to the price of milk are also shown. For the 34-year period the average price has been $2.23 per hundred pounds for milk. This ranged from the highest price for 1919 of 152 per cent of the average down to the low point for 1932 of 61 per cent of the average. In 1943 it was back up to 139 per cent of average and will be higher in 1944 because of the incentive payments.

Several observations can be drawn from these data on milk prices but the most significant observation is that these prices have no direct correlation with total milk production. Most persons anticipate a decline in the general price level in the postwar period. Obviously milk prices will drop too but the data here indicate it is erroneous to conclude therefrom that milk production will also drop. On the contrary there appears a tendency for an acceleration in milk production under the conditions that may be anticipated in the postwar period.

Other data confirming this latter observation are shown. As stated, in years of agricultural prosperity relative interest in the dairy enterprise tends to subside. Conversely, in depression years relative interest in dairying increases.

A curve is presented to show the annual gross farm income in the United States from 1910 to 1943, the average being $10,850,247,000. A companion curve is also carried to show the per cent of the gross farm income that was due to the sale or home use of dairy products. On the average 16.1 per cent of the gross has been due to these dairy products. During World War I gross farm income rose to 157 per cent of the average, but dairy products contributed only about 12 per cent of the gross. In the two years following that war gross farm income dropped from 157 per cent of the average down to 92 per cent. In the same period there was a rise from 12 per cent up to 16.8 per cent in the portion of the gross that was due to dairy products.

The depression year of 1932 marks the low point in gross farm income. It was only 55 per cent of the average. In that year, the per cent of the gross that was due to dairy products rose to 22.4, the highest percentage in history.

There is full recognition of the fact that no one can predict with certainty the conditions that will confront the dairy industry in the postwar period. However, I venture my interpretation of the data as follows and I perceive if these predictions materialize the resulting condition will bring more serious problems than the dairy industry has ever before encountered.

1. The general price level as well as dairy prices will decline.

2. Even with such declines it should not be surmised that milk production in this country will subside.

3. On the contrary, as all farm enterprises become less remunerative, there will be relatively more interest in the dairy enterprise to utilize most effectively the farm-grown feeds and the abundant farm labor likely to be available.

4. With this continued liberal milk production in the face of likely curtailed consumer purchases, profit margins will be reduced and in many cases will disappear.

5. One solution to the likely problems lies in the dairy producer's ability to breed, feed and manage his dairy herd with a degree of efficiency not heretofore achieved generally.

6. Another opportunity to help solve the problems lies in sincere appreciation by producers and processors of the necessity of choicest quality in dairy products. This and the consequent elimination of inferior products from consumer channels are indispensable if the industry is to survive the impact of the postwar period.

7. No group of persons involved in the dairy industry will face more strenuous demands for service nor be able to render greater immediate service than the extension workers—those identified with colleges, the breed fieldmen, plant fieldmen and all who are devoted to dairy educational work.

D. Postwar Demand for U. S. Livestock Abroad. O. E. Reed, *Chief, Bureau of Dairy Industry, Agricultural Research Administration, U.S.D.A., Washington, D. C.*

It is difficult to make a reliable appraisal of the postwar demand for purebred livestock in Europe and South America; first, because the postwar agricultural and economic conditions cannot be determined at this time, and secondly, because we have very little information about the present status of the livestock situation abroad, particularly in those countries that have been overrun by the enemy.

We do know, however, that livestock numbers have been reduced substantially in northwestern Europe, where normally there is heavy dependence on imported feed grains and oil cakes. Inability to import these feeds means that the greatest reductions have occurred in hog and poultry numbers. Sheep numbers by contrast have been well maintained.

Piecing together all available information, it appears that for the European continent as a whole the decline as of 1943 was about 10 to 15 per cent below 1939 in the case of cattle, and approximately 30 to 35 per cent in the case of hogs. Sheep numbers may even have increased.

As a result of these developments, the productive capacity of the European livestock industry has been accordingly reduced. Total meat production is estimated at about 70 per cent of prewar production; eggs at about 60 per cent; whole milk for fresh consumption at about two-thirds of prewar; cheese at about two-thirds; and butter at approximately 80 per cent.

The knowledge that European countries have suffered considerable losses in livestock numbers naturally has created interest among livestock men and others in the United States. Consequently, there has been much discussion about the role this country may expect to play in restocking and developing the livestock industries in Europe. Many statements have been made expressing an optimistic view of the possible demand for our livestock. In my opinion, such statements have been based on wishful thinking rather than on a practicable consideration of the probabilities.

In any event, I doubt that there will be any great demand on United States farmers and livestock breeders in the near future. Even if hosilities should cease in Europe in 1944, it would be a year or more before the governments of the depleted countries could make arrangements to import any considerable number of livestock.

Also, there seems to be a widespread notion among some of our breeders of registered dairy cattle that such stock will be in great demand when rehabilitation programs are under way. In talking to many of the representatives of the occupied countries who have expressed an interest in obtaining dairy cattle when the proper time comes, I find that they are interested primarily in obtaining cows for utility purposes and they are not interested in registered breeding stock, except possibly a few outstanding proved sires. It is well to remember in this connection that most of the European countries that plan to import breeding stock will want the breeds they are now using. This is true of all kinds of livestock and consequently not many countries would be interested in the breeds we have to offer.

Apparently the first thing that will be given consideration by those in charge of rehabilitating the war-damaged countries will be the problem of obtaining food supplies for the starving populations as quickly as possible and in the most feasible manner.

No doubt the demand for food in all war-damaged countries will emphasize the need for livestock products, particularly dairy products. Consequently, emphasis will be placed upon the rebuilding of the livestock industries in these countries as soon as practicable. However, I do not believe there will be any sudden demand for large numbers of breeding stock from this country. Most of those with whom I have discussed the probable situation seem to agree that the rehabilitation of herd and flocks in the European countries after the war will be primarily a matter of encouraging the natural increase in numbers as soon as feed is made available, and that relief by livestock shipments from overseas will probably not be in great volume.

In regard to Latin America, the possible demand for our purebred dairy cattle is more favorable. But even this market would not call for a large number of breeding animals, at least not for some time. Demand for breeding stock of the dairy breeds is increasing in Latin American countries,

particularly in the tropical countries and in those on the Pacific side of South America. This demand probably will continue after the war as long as the purchasing power of those countries remains relatively good. But cattle buyers who come to us from these countries will need advice and help, so that they can obtain the right kind of cattle for their conditions at a reasonable price. Such assistance will be an important factor in developing this foreign market.

In many areas of Latin America, particularly in the tropical lowlands, our dairy breeds have not proved entirely satisfactory. In most instances the imported animals have had to face such obstacles as heavy infestation with cattle tick and other parasites, less satisfactory feeding and management than that to which they had been accustomed, as well as high environmental temperatures. Frequently, such conditions have been responsible for failures that were wrongly attributed to a breed's inability to withstand tropical conditions.

More research work will be needed to determine the effect of continued high temperature on the productive and reproductive performance of improved breeds of dairy cattle. The dairyman in these countries needs help in the way of education and research to enable him to create a better feeding and management environment in which to maintain the cattle he imports or the descendants of such cattle. This really ought to precede the importation of large numbers of cattle. In other words, it will first be necessary to assist dairymen in informing themselves as to latest and most modern methods of taking care of good cattle. The possibility of developing a suitable tropical dairy type by grading up the native stock with our purebred breeds should not be overlooked.

Education and research organizations and associations, such as the American Dairy Science Association, could do much to foster education and research in the dairy field in Latin America. Within the last two years the Bureau of Dairy Industry, in cooperation with the Department's Office of Foreign Agricultural Relations, has sent three men to a number of South and Central American countries to survey dairy conditions. Dr. Hodgson, who will discuss the dairy industries in Latin American countries on this program, was accompanied on one trip by Dr. Hunziker and on the second trip by your own president, Dr. Dahlberg.

These surveys have made us aware of the rapidly developing interest in dairying in Latin America, and also of the fact that there is a potential market for U. S. dairy equipment and supplies of all kinds, including some dairy breeding stock. Before this market will materialize, however, more attention will have to be given to educational and research programs in those countries in order to help the farmers and livestock men there acquaint themselves with modern ideas and practices relating to the dairy industry.

F. Nutrition Education as a Safeguard Against Postwar Surpluses. E. M. HARMON, *Director of Public Relations, National Dairy Council, Chicago, Ill.*

Aside from production shifts there are two factors which may make for dairy surpluses in the postwar period. The first of these is changing food habits on the part of consumers. The second is the return to our markets of products now going to foreign nations for lend-lease and other purposes.

In connection with the first, it is certain that food habits are changing. In an extensive survey by the New York *Times* recently, 75.8 per cent indicated changes in food habits due to rationing. Of these, 55.2 per cent indicated that those changes were substantial.

When asked what the changes were, 84.8 per cent said that the most important change was a shift to oleomargarine. This far exceeded any other food change.

The effect of this change in food habits may be gained from the realization that there are now only about 12 pounds of butter available per person per year. This compares with the about 17 pounds in the prewar period. That 5-pound drop represents considerably over 600 million pounds of butter which in terms of milk equivalent means more than 12 billion pounds of milk or more than 10 per cent of the nation's milk supply.

Nor is this the only food habit change that may plague the dairy industry when supplies are normal. Cheese consumption is cut from about 6½ pounds in the prewar period to an estimated 4.2 pounds available for 1944. Cured cheddar cheese is almost unknown, and if this condition prevails long enough the appetite for that type of cheese may be largely lost. Candy manufacturers are finding substitutes for dairy products. Bakers who were fast learning the value of milk solids have been forced to abandon them.

This is not the first experience of this kind that the dairy industry has encountered. The fat shortages in the first World War led to a reduction in per capita butter consumption from 18 pounds per year to 14 pounds per year. Five years were required to get back the normal butter consumption, and that was not nearly as drastic a shift in food habits as is the present one.

Nor is the dairy industry alone in this type of experience. Meat rationing in the form of meatless days in the last World War caused changes in food habits that have plagued the meat industry ever since. Wheatless days caused a permanent shift in food habits. According to the Bureau of Agricultural Economics we consume 18 per cent less wheat per capita than at the beginning of the first World War. The coffee industry, so far, has found itself unable to restore the consumption of the prerationing period. These observations lead to the question of: What shadows do the present changes in food habits cast upon the dairy horizons of tomorrow?

As an answer, some wishful thinking in the dairy industry forecasted vastly expanded European markets for many years to come. No one can

presume to have a positive answer on that point. Even could we know just what the dairy herd of Europe is today, the route or routes the invasion takes, the time required and the intensity of the fighting will all have a great bearing on what that herd is when the war ends.

The limited information available seems to indicate to date that the dairy herd of Europe is fairly well intact. Dr. Karl Brandt, head of the Research Foundation of Leland Stanford University, estimates the cow population is on the increase in many sections of Europe. Dr. Brandt estimates that while hog and poultry population have been severely cut, the productive dairy herd of Europe is probably not nearly as drastically reduced as supposed by many. Due to his close connections with agricultural economists in the continent of Europe and particularly in Sweden and Switzerland, Dr. Brandt is credited with being one of the best-informed men on European agriculture today.

The explanation is that Europeans have killed the grain-consuming animals. Since cows are not necessarily competitors with humans for grains but can be maintained on a subsistence ration of roughages they have been spared till the last. If these observations are correct, then it seems likely that Europe will come back to normal dairy production with reasonable rapidity once trade relations are open and their normal supply of 100 million tons of grain a year becomes available. Such would speed the day when the dairy industry of America must look to the home market as practically the sole outlet for its products.

Coming to the consumer, to whom we must look as the ultimate buyer for all of our dairy food products, even the most casual observer will note a receptive mind for nutrition information. Numerous factors have contributed to this situation—military draftee rejections, nutrition education in factories and war plants to overcome fatigue periods, accidents and absenteeism and the national nutrition program which is patterned largely upon the one which the dairy industry founded in 1918.

Every branch of the food industry is aware of this situation. Smart merchandisers know that food habits are changing and all are busy trying to either profit by those changes or to avoid any long time losses from them.

In this connection the educational and professional groups are confronted with difficult problems. Teachers have children in their school rooms from homes where both parents are working and where there is less chance to protect the child's nutritional habits than before. In factories and war plants individual nutrition specialists are charged with the responsibility of building and guiding nutritional habits which will make for maximum efficiency of workers. Doctors, dentists, dietitians, home economists, nurses and public health officials are confronted with the same problems.

All appreciate the merits of the slogan: "Make friends before you need them." These groups, charged with the responsibility of the education

and health of the nation, need friends and need assistance, and hundreds of thousands of them are finding at least some of that help in Dairy Council materials and the aid of the nutrition specialists of the Dairy Council units. A survey among 2600 teachers recently publicized in "Printer's Ink" emphasizes this point. Among this group 93.5 per cent wanted other teaching materials in addition to textbooks. Only half of them, however, found other such materials suitable. Such comments as "Too much sales promotion"; "Not geared to existing school programs"; "Not technically correct"; "Too much use of trade names" were prevalent. All of this points very definitely to two conclusions. First, practically all teachers want additional teaching helps, but, for the most part, industry has not been smart enough to provide them with the type of helps they need.

On the question of the type of subjects where they especially needed assistance, 76⅔ per cent of them asked for food and nutrition material. This was far ahead of any other classification.

The National Dairy Council program is geared into just this kind of an outline. A committee of nationally known educators meets at least four times a year with the nutrition group of the National Dairy Council and a committee of local unit directors to advise with them as to just the type of educational materials most acceptable to schools and professional groups. This Advisory Committee includes an outstanding leader in the primary education field, another in the intermediate, and a third in the adult education field.

The same story will be told differently and with a different type of material for people of different age and education levels. For example, the story of calcium in milk would be told quite differently to the youngster in the primary grades than to the one in the intermediate grades and certainly far differently than to the dentist. This results in a course of study which lasts throughout the school period and on into the adult and professional groups. In this respect the dairy industry educational program is unique. Furthermore, all such materials are pre-tested under actual conditions.

The prestige of the Dairy Council has been gained due to the comprehensive yet unbiased nature of the nutrition education program of the dairy industry. As such it has become effective with nearly every educational, professional, civic, consumer and governmental group in any way interested in public health and welfare.

There are plenty of evidences of the value of nutrition education work throughout the nation. The recent New York *Times* survey mentioned earlier in this paper indicated that next to rationing, nutrition education is of the greatest importance in determining food habits. When we turn to the national picture the fighters' ration today indicates definitely that there have been some drastic changes in thinking during the past 25 years. In the first World War, 11 ounces of milk a day were required to make all of the

dairy products included in the garrison ration. In this World War 37 ounces of milk per day are required to make the dairy products in the garrison ration of one soldier.

Coming out to the local areas we find an even more impressive picture. In 1941 the Bureau of Agricultural Economics reported that 4 per cent more milk was sold in cities and villages than in 1940. A survey made by the National Dairy Council and including areas containing about 68 per cent of the entire population of the United States in cities of over 100,000 showed 6.2 per cent increase in cities having Dairy Council programs and a 1.5 per cent increase where there was no Dairy Council.

In the following year, 1942, compared with 1941 the Bureau of Agricultural Economics indicated an increase of 8 per cent in the amount of milk sold in cities and villages. Using the same procedure it was found that sales increased 10.9 per cent in cities maintaining active Dairy Council units and only 5.3 per cent in those not so doing. With the inauguration of the FDO orders sales restrictions were imposed in different areas during the latter part of 1943 so that this trend was somewhat checked.

This constant trend offers convincing proof of the importance of nutrition education work in the postwar plans of the dairy industry. Such a program, of course, should be backed up by additional research on the nutritional values of dairy products in experiment stations and laboratories. It will gain materially from the added impetus from advertising and point of sale efforts by the American Dairy Association as well as brand promotion by commercial organizations within the industry.

Steady, consistent, long-time gains and permanent stability of demand requires as a fundamental support a sound, comprehensive nutrition education which reaches the home from every angle—the teacher, the school, the dentist, the doctor, the public health official, the civic clubs and the women's organizations. Such a program should not be thought of as a cure-all, but it is a potential factor toward the relief of the surplus problems of the postwar era.

G. Postwar Problems in Country Collection and City Delivery of Milk.

LELAND SPENCER, *Cornell University, Ithaca, N. Y.*

The collection of milk from the farms and the delivery of milk to consumers in the city are at opposite ends of the chain of marketing operations. However, they have one thing in common. The main essential for low unit costs in each of these operations is large loads.

Country hauling. The average cost of hauling milk from the farms to dairy plants in New York State is about 16 cents per hundredweight, or 1/3 cent a quart. Most of the hauling now is done by commercial haulers. Only about one-fifth of the dairymen in New York State still haul their own milk to market.

Unit costs go up rapidly when loads fall below a reasonable level which depends upon the hauling distance and the size of truck being used. Hauling distances have increased due to the consolidation of country plants. On the other hand, larger loads are being hauled on the truck routes because fewer dairymen are attempting to haul their own milk. Consequently the rates charged for hauling held about steady until the last two or three years, during which time there has been an advance of 10 to 15 per cent.

Further economies in country milk hauling are to be sought mainly by reducing the number of haulers. The most practicable way of doing this appears to be through supervision of hauling arrangements by the producers' associations or the plants that receive the milk. Some cooperatives have been quite successful in obtaining rate reductions by contracting with the haulers, assuring them of good-sized loads and protecting them from the demands of individual producers for special service. This type of supervision is much to be preferred to the regulation of services and rates by public service commissions. It is practically impossible for public regulatory agencies to make proper allowances for the many local differences that have a bearing on milk hauling services and rates.

City delivery. The cost of delivering milk from the processing plant to the doorstep varies from about 4 cents to 7 cents a quart. The cost is higher in large cities than in smaller places and also tends to be higher in the North than in the South.

The principal element in the cost of milk delivery is the compensation of labor. Weekly earnings of driver-salesmen have gone up sharply in recent years. In New York City the average weekly earnings were nearly three times as much in 1943 as in the years immediately preceding World War I. Meanwhile the work week has been reduced from 7 days to 6, vacations with pay have been granted, and social security privileges have been provided.

Similar gains in the earnings of other groups of workers have been offset by increased output per man, but this was not true in milk delivery prior to the advent of every-other-day service. In fact, for many years prior to 1942, there was a gradual decline in the size of loads carried on retail milk routes in the large cities, such as New York and Chicago. The change from daily delivery to every-other-day service, which was made in 1942 and 1943, is by far the most important step ever taken to increase the size of loads and reduce the unit costs of retail milk delivery. Except in those markets where the earnings of driver-salesmen consist largely of commissions, the saving of manpower, together with the saving in truck expense, through every-other-day delivery has been sufficient to offset wartime increases in other costs. In some markets the distributors' spread has been reduced, while the drivers are earning more with fewer hours of work.

The most important question facing the fluid milk industry today is "How can the gains in efficiency of delivery through every-other-day service

be retained after the war?" Presumably the federal regulations under which every-other-day delivery was initiated and maintained during the war will not be continued in peacetime. When these regulations are discontinued, it is very probable that one or more distributors in practically every market will again offer daily service as a means of attracting additional customers. In order to cope with this type of competition, distributors who wish to maintain the E.O.D. system must offer suitable price concessions for the more limited service, even though temporary losses may result.

In the markets where the driver-salesmen are strongly unionized, much will depend upon the attitude of the union leaders. It seems clear that continuance of every-other-day delivery will be to the drivers' advantage. Daily service might seem to call for the employment of more drivers. However, if the E.O.D. system were abandoned, it would be impossible to maintain the present level of weekly earnings without a sharp increase in costs. The effect of this would be to accelerate the shift from retail delivery to store distribution, and from fluid milk to canned milk and dried milk, thereby causing a permanent reduction in the number of drivers employed.

In those states where milk control agencies have the authority to fix retail prices, lower minimum prices should be allowed where deliveries are made on alternate days.

III. DEHYDRATED MILK AND MILK PRODUCTS

A. Present Developments of the Dried Milk and Milk Products Industries in the U. S. A.

P. H. TRACY, *Department of Dairy Husbandry, University of Illinois, Urbana, Ill.*

The urgent need for dried food products for use by our Army and Navy and for shipment abroad has greatly stimulated our interests in the perfection of methods of manufacturing and packaging dried milk and related products. The production of nonfat dry milk solids has increased from 16,463,000 pounds in 1916 to 449,291,000 pounds in 1938. The demand for this product for use in the food industries will likely increase in the postwar period.

The future of dried butterfat in this country is uncertain. There is some question as to whether or not producers here will be able to compete with those of New Zealand and Australia in a postwar period devoid of trade barriers.

Much remains to be learned about the proper method to manufacture powdered ice cream mix but the indications are that the product will be one of considerable importance in the postwar period.

The production of malted milk has remained practically unchanged during the past 25 years. The consumption of this product increases in years of prosperity and decreases when business conditions are unfavorable.

The manufacture of dried whey has nearly trebled in the last five years. The less whey placed in the sewer or used for stock food and the higher the proportions used for human food or medicinal purposes, the more economical will cheese-making operations become.

The merits of dried buttermilk as a food for poultry and hogs has been recognized for some time. Sweet cream buttermilk has been found satisfactory for human food. From the standpoint of efficient utilization of milk solids, the establishment of whole milk creameries of such size that they can profitably manufacture dried defatted milk or sweet cream buttermilk seems a logical procedure.

The estimated production of powdered whole milk for 1943 was 124,300,000 pounds or nearly 60 times that of 1916 and over 4 times the production of 1940. A problem for research workers is to perfect methods of manufacture and distribution that will result in a powdered whole milk, and possibly a powdered cream, that will have good keeping quality, that can be easily reconstituted, that will have a normal taste and feel in the mouth, that will have a normal appearance in the glass, and that can be sold at a price that will be attractive to the consumer.

The future of the dried milk industry will depend largely upon research. Both industrial and institutional research will be necessary to learn what should be known about the proper methods of manufacture, possible new uses of the dried milk and milk products, and a more complete knowledge of the nutritional properties of these products.

B. Revision of Specification on Milk Powders. LT. ROBERT REMALEY, *Subsistence Research and Development Laboratory, U. S. Army Quartermaster Corps.*

During the past sixty days, the Quartermaster Corps has published a new specification for dry whole milk and nonfat dry milk solids—No. 166A, dated 8 April. This specification supersedes all other specifications insofar as Army purchases are concerned.

Because of the more rigid storage requirements of the Army and because of the expansion of production of milk powders, the new specification controls more closely the four factors which appear to be of the greatest importance in the production of a palatable milk powder; namely, moisture, iron and copper contamination, raw milk supply and the oxygen content of the gases surrounding the packaged product.

Controlled laboratory studies as well as milk powders returned from the field have indicated that when the requirements of the new specification have been complied with, that whole milk powder will remain palatable for as long as 18 months even under adverse conditions of storage. Laboratory experiments have also indicated that as the temperature of storage increases the necessity for proper control of the four factors mentioned increases.

Variances in result of testing laboratories on identical samples are beyond the normally expected experimental error. Increased numbers of samples and inexperience of the analyst probably account for some of this variation. As a result, two programs are being initiated by the Quartermaster Corps Subsistence Research and Development Laboratory. One program, under the supervision of the American Dry Milk Institute, is an intensive study involving 576 determinations on identical samples in 8 laboratories on fat, moisture, titratable acidity and bacterial count in order to establish experimental errors. The other program is more extensive and involves all analytical procedures, which are required by the new specification. Over twenty-five laboratories including Government, Army, Universities and Industry are collaborating.

C. Dehydrated Milk and Milk Products, Use of Antioxidants. S. T. COULTER, *Dairy Division, University of Minnesota, St. Paul, Minn.*

The prevention of talliness is a major factor in the storage of dry whole milk and other high fat dehydrated milk products. Although not today added commercially to dry milk, antioxidants are used in some fatty foods.

The following statements with respect to the effectiveness of various antioxidants in dry whole milk are based primarily on published experimental work. (1) Oat flour added in amounts equivalent to about 2 per cent of the weight of the milk solids delays the onset of talliness. (2) Hydroquinone in amounts equivalent to 0.01 per cent of the weight of the milk solids is definitely antioxygenic, but its use has been objected to by Pure Food and Drug Officials. (3) Wheat germ oil concentrates added at the rate of 0.1 to 0.2 per cent of the weight of the fat is comparable in effectiveness to hydroquinone. The antioxygenic activity of wheat germ oil is enhanced by the addition of citric acid. (4) Ascorbic acid at the rate of about 0.1 per cent of the weight of the milk solids retards oxidation. This is doubtless an example of the synergism that has been shown to exist between the tocopherols and many acids. (5) Gum guaiac and nordihydroguaiaretic acid are effective antioxidants but may cause the development of a fruity flavor. (6) Other substances have been shown to have some antioxygenic effect in dry whole milk. Much experimental work on antioxidants is now in progress. More effective antioxidants may be found.

Milk itself contains appreciable quantities of natural antioxidants, notably tocopherols and ascorbic acid. Reducing substances which are definitely antioxygenic may be produced in milk by heat treatment. The preservation of the natural antioxidants together with the use of processing treatments to secure the optimum antioxygenic effect should be the first recourse of the industry.

D. Army Packaging and Packing of Dried Milk Products. MAJOR JAMES D'A. CLARK, *Subsistence Research and Development Laboratory, U. S. Army Quartermaster Corps.*

Present Army requirements for dried milk products are discussed, including skim-milk powder, whole-milk powder, ice cream powder, and dehydrated cheese, together with a presentation of Army requirements for labeling, packing, and marking of shipping cases. The reasons for the various requirements are briefly reviewed with comments on the possibility of improving the keeping quality of whole dried milk which is, for many reasons, a product of more than usual importance.

E. The Future of the Dehydrated Milk and Milk Products Industry. J. T. WALSH, *American Dry Milk Institute, Chicago, Ill.*

War conditions have placed a sudden emphasis on the importance, adaptability, and nutritional value of foods—especially non-fat dry milk solids, dry whole milk, dry ice cream mix—for use by the Armed Forces and by Lend-Lease.

The dry milk industry, while yet a young, robust, and growing industry, has been established on a sound basis for approximately the past 20 years. It cannot be regarded as only a "war baby," which, of course, cannot be said of many types of dehydrated food products. The dry milk producers have invested much money in research development, and market expansion for their product. Their foresight and the soundness of their program, both in the past and at present, is readily reflected in Government set-aside requirements for Armed Forces and Allied uses. The industry has gained consumer acceptance of its products, all of relatively high nutritional value.

In the postwar period particular emphasis unquestionably will be placed upon "high quality." Dry milks are products whose quality is directly influenced by the quality of the raw material (fluid milk) used in manufacture. Not only will quality be a consideration, but indeed "uniform" quality will be equally as important.

The development of uses and the production of non-fat dry milk solids, dry whole milk, dry buttermilk, dry whey, and other dry milk products are to be regarded in the light of domestic markets as well as possible foreign markets.

Convenience of usage by the consumer can affect market development for dry milk products. This constitutes a real problem for the dry milk producers because of the physical characteristics of these products. (Most of them are very hygroscopic and are subject to rapid flavor and odor deterioration when improperly packaged.)

It is possible that all of the splendid work accomplished by the industry to date will continue to develop in a manifold manner in the future, depending upon how wisely the industry plans its research, quality development,

application and market development, now and in the years immediately preceding the conclusion of the war; recovery from war requirements.

IV. MASTITIS

A. Mastitis: From the Dairyman's Viewpoint. T. S. SUTTON, *The Ohio State University and The Ohio Agr. Expt. Sta.*

During the past several years significant contributions to the treatment of this serious disease by the use of chemotherapeutic agents have been made. In certain instances the reports of these researches may have given rise to unwarranted hope and a false sense of security on the part of the practical dairyman because the first responsibility in the control of this disease still rests with the man with the cows and will probably continue to do so for a long time in the future. Contributions from the field of Veterinary Medicine have been of significant help; yet without a thorough understanding of the disease and the exercise of careful sanitary procedures and sound management practices on the part of the dairyman himself, there is little hope of ever bringing the disease under control.

In order that the dairy farmer be enabled to control mastitis in his herd, an educational program based on the following fundamentals should be carefully planned and carried to him:

1. An understanding of the internal structure and physiology of the mammary gland. The purpose of this is to make obvious the difficulties encountered in getting rid of the disease once it has gained a foothold.
2. The cause of the disease and the ways in which the infection is usually spread.
3. The predisposing causes which may lower the resistance of the gland to infection.
4. The effects of the disease on the gland and the milk secreted and practical methods of detecting the disease.
5. The effects of the disease on the production of milk and on the quality of dairy products.
6. Sound dairy management and milking practices to control the severity of the disease and the spread of the infection.

The dairyman with a practical working knowledge of these subjects can best utilize the services of the veterinarian in the treatment of the disease.

B. Modern Methods of Treating Mastitis. C. S. BRYAN, *Michigan State College, East Lansing, Mich.*

The proper diagnosis must be made to successfully utilize the udder infusion treatments in a program for the control of mastitis. One of the bacteriological tests must be used to determine whether infection is present or absent, and a careful physical examination of the udder must be made to

determine the condition of the udder tissue. Evidence, at hand, indicates that udder infusions are of no value in non-infectious mastitis and in cases of infectious mastitis with marked areas of fibrosis. The proper diagnosis and treatment must be supported by an adequate sanitary program to insure successful control of bovine mastitis.

LATIN AMERICAN DAIRYING

A. Dairy Farming in Tropical America. R. E. HODGSON, *Bureau of Dairy Industry, Agricultural Research Administration, U. S. D. A., Washington, D. C.*

Studies of the dairy industries of El Salvador, Honduras, Nicaragua, Costa Rica, Panama, Colombia, and Venezuela were made by the U. S. Department of Agriculture at the request of the Coordinator of Inter-American Affairs. These countries are in the tropical zone but the climatic temperature varies with the altitude. Farming is pursued in all altitudes up to about 12,000 feet. Altitudes of 4,000 feet or above appear most favorable for dairying.

Farming is the principal occupation; the major crops being coffee and bananas for export, and corn, rice, sugar cane, and beans for local consumption. The production of food crops is limited because of lack of the most modern cultural methods, infertile, depleted soil, and small acreages under cultivation. Foodstuffs must be imported in many areas.

Cattle raising is an important agricultural pursuit. The cattle population in the 7 countries is about 15 million, or 65 head per 100 people. Most of the cattle are Criollos, descendants of the Spanish cattle introduced by the colonists. They are about the size of the Jersey or Guernsey and vary in color from light yellow to red. They are multiple-purpose animals, raised for milk, beef, and draft. The average milk production is low and the lactation period short. Local production permits a per capita consumption of milk in all forms equivalent to about 1/3 pound daily.

Improvement in the quality of the native cattle has been attempted by crossing and grading with imported Brahman cattle as well as with imported purebred dairy breeds. The Brahman has increased size and improved resistance to tropical conditions but has not materially increased milk production. The purebred dairy breeds have met with varying success. In the hot lowlands under feeding and care not best suited to their needs they have not done well. This failure probably can be attributed more to management factors rather than to their inability to adapt themselves, although they apparently do lack heat tolerance compared to the Criollo or Brahman cattle. In the highlands the purebred dairy breeds do well under proper feeding and management, and grading up the native stock with them offers the best method for rapid improvement. In the hot lowlands improved strains of

resistant Criollos may be the best type, since they probably would produce as much milk as the environmental conditions on the average farm would permit any breed to produce. Dairying should be concentrated in the highlands.

Cattle improvement would be expedited by fencing the pastures and confining the bulls so that breeding could be controlled. More care is needed in selecting breeding animals. Farmers ought to keep breeding and production records and use them in selecting breeding stock. Dairy-herd-improvement programs need to be established by the national departments of agriculture to assist farmers in developing higher producing herds.

Feeding and management conditions on farms must be improved if high yielding cows are to produce efficiently. Cows are maintained on pasture all year; but in the numerous areas where extended dry seasons occur, pastures dry up and because of deficient feed supply the cows lose weight, fall off in production, and go dry. Lowland pasture grasses are of the coarse bunch type while in the highlands the fine-leafed grasses predominate. Progressive farmers supplement pasture with soiling crops such as corn, sorghum, or banana stalks. Silage is becoming more popular and offers the best way of improving the year-round feed supply. Hay is practically unknown but could be used extensively. The feeding of concentrates is limited largely to market-milk areas. Corn, sorghum, rice bran and hulls, coconut meal, cottonseed meal, and sesame meal are the most popular concentrates.

Knowledge of the feeding value of local feeds and existing nutritional deficiencies is limited. Calcium, phosphorus, and iodine deficiencies are suspected in some areas. Vitamin A may be lacking during extended dry periods when pasture is not supplemented with green feed or silage.

Primitive methods of raising calves result in slow growth, late maturity, unthriftiness, and high mortality. Calves should be weaned soon after birth, confined to pens and raised on an adequate ration rather than allowed to run with the cow and nurse at will or allowed to suck as a part of the milking process.

Parasites, particularly the cattle tick, and numerous diseases are prevalent and account for high mortality. Disease control measures are lacking on most farms and the veterinary service is limited or non-existent.

The governments are giving encouragement to dairy development by establishing schools and experiment stations. The U. S. Department of Agriculture is cooperating in this development in some countries by lending leadership and scientists for experiment stations. The Inter-American Institute of Agricultural Sciences, a research and educational institution, is being developed under the auspices of the Pan-American Union. This institution, located in Costa Rica is designed to train students and to conduct research in all phases of the agriculture of the Americas. At present it is supported

by the U. S. Government through a grant of funds from the Coordinator of Inter-American Affairs to the Pan-American Union, but support in the near future will come from the several American Republics that desire to participate financially in this important work. These various educational and experimental organizations will do much to improve agriculture and cattle farming in the areas which they serve. There is need also for further development in agricultural and livestock extension work.

B. Central American History, People and Industry. A. C. DAHLBERG, *Cornell University; Ithaca, N. Y.*

An understanding of Central America must be based upon a knowledge of its early history, people and industry. The Indians who inhabited the country when discovered and conquered by Europeans were advanced in the civilization of that time. The Spaniards lead in the conquest and are today the leading European race. They tended to rule and exploit rather than settle and develop. Today the Indian still predominates with a small percentage of Negro and European except in Costa Rica where Europeans constitute the bulk of the population.

Judged by our standards, which is probably not fair but there is no other basis available to us, these countries are relatively poor and undeveloped. This is not entirely a problem of races and climate for there are regions populated by Europeans, and at higher elevations the climate is temperate. These countries are rather small in comparison with all northern neighbors. They need to develop transportation, especially roads and railroads, to avoid excessive isolation in many localities. They need development in many national projects such as public health, schools, agriculture, industry, etc. These things can be done only when sufficient funds can be raised by public taxation to permit the governments to be more active in promoting projects for the common good. The income of the average person needs to be increased to develop a more prosperous middle class. Some home industries together with agricultural advancements would materially assist along these lines. Finally, such developments would give a much greater proportion of the population from which leaders could be selected for election or appointment to the office required by their democratic forms of government.

The United States can be of much assistance to these nations by friendly cooperation over the years to enable Central America to develop itself to the fullest extent. Such a policy is mutually advantageous.

C. The Dairy Products of Central America. A. C. DAHLBERG, *Cornell University, Ithaca, N. Y.*

Increased per capita consumption of milk and milk products would improve the nutrition of the people of Central America. The present milk supply available for all purposes varies from 0.2 to 0.7 pounds of milk per person per day.

The three principal dairy products are milk, cheese and butter. Milk is boiled before use and is served chiefly as coffee with hot milk. There are a few good milk-pasteurization plants. These plants might very advantageously make cheese, milk drinks, and ice cream mix. The sanitary quality of the milk is generally poor but there are notable exceptions.

Fresh rennet-curd, highly-salted cheese predominates with some cured soft Muenster type and a little cheddar cheese. The fresh curd cheese probably has 5 per cent salt and is sometimes smoked. The milk is often partially skimmed. The cheese is nearly all made on farms. Cured cheese ought to be more generally manufactured to conserve milk solids from periods of surplus to the dry season. The people are fond of cheese.

The butter is made on farms from raw cream churned about twice weekly. In the higher altitudes some good farm butter is made but in the tropical climate the butter is greasy and spoils quickly without refrigeration. In such areas the production of butterfat should be preferred to butter.

Ice cream production is very restricted but is increasing. There are a few ice cream plants. There is one condensed milk plant. It is doubtful, however, that sufficient milk is available to warrant condensed and dry milk plants.

There is every reason to encourage dairying in the higher altitudes where the excellent grass, good water and temperate climate favor the industry.

D. Thomas Jefferson in Agriculture. O. E. REED, *Chief of the Bureau of Dairy Industry, Agricultural Research Administration, U. S. Department of Agriculture.*

Last year marked the 200th anniversary of the birth of Thomas Jefferson, the third President of the United States, who was born in Albemarle County, Va., April 13, 1743.

Early in 1943, Congress passed a resolution urging National recognition of the birth of this great American by recalling his many public services. Every school boy and girl knows that Thomas Jefferson wrote the Declaration of Independence. He also served as Governor of Virginia, U. S. Minister to France, Secretary of State, and President of the United States.

Although his life was largely devoted to public service for the Nation he helped create, Jefferson considered himself a farmer. His letters and records indicate his keen interest in agriculture, and in experimental methods and inventions for its improvement. In the field of agriculture he was as much a leader as in the field of statesmanship.

It is entirely fitting and natural, therefore, that this Association pay tribute to Thomas Jefferson, the farmer, the scientist, the extension leader.

Jefferson regarded agriculture as a profession on a level with other professions. He considered agriculture a science and thought that professional scientific people were needed for its development. He felt that colleges

should make provision for training and education in agriculture, the same as in other professions. He also recognized the need for getting scientific agricultural knowledge to farm people. Thus he was among the first of our great leaders to think about the objectives for which our agricultural colleges and experiment stations were eventually founded.

In Jefferson's day, the one great industry of the State of Virginia was agriculture, but this was still of the plantation type, with landholdings in large acreages, and a one-crop system predominating. Tobacco and grains were grown for export, year after year, and eventually tended to deplete the land of its virgin fertility. As a result, the farms quickly became run-down and very much eroded.

In his travels in Europe, as well as in the United States, Jefferson had an opportunity to see many different farming conditions and methods. He felt that pioneering methods in Virginia could be improved. His observations and interest led him to make a test farm out of his mountain-top plantation at Monticello. He planted domestic and imported trees and seeds, and kept minute records to see whether foreign specimens could be adapted to the soil and climate of this country.

He kept a farm book in which he recorded interesting observations about farming, and soil fertility. For example, in his farm book he mentioned a suggestion by John Taylor, an eminent agriculturist of Caroline County, Va., about the use of cattle manure. The quotation from his farm book is as follows:

"Mr. Taylor says he knows by accurate and constant experience that 40 head of cattle folded of nights only, dung completely 20 yards square. Before folding, the ground should be coultered and covered with straw, then folded one week and the straw and dung immediately turned in with the great plough."

Then Jefferson himself recorded an experiment to be tried, comparing a mixture of cow manure and sheep manure applied by the "folding" method, with a field where direct application of manure was made without "folding." He also wrote that rotted manure should be applied in December, January, or February at the rate of 25 loads per acre, and that it would be well worthwhile to confine and litter cattle in a yard through the summer —each head would then manure an acre a year.

During Jefferson's first long absence from Monticello in the public service (approximately from 1784 to 1794), his fields suffered from neglect under overseers' management. When he returned in 1794 he worked out a system of crop rotation to restore fertility. He divided his farm into six fields to be put under this rotation: First year, wheat; second, corn, potatoes, and peas; third, rye or wheat; fourth and fifth, clover; sixth, folding and buckwheat dressing.

He was also aware of soil erosion and had a suggestion for its control, as is indicated by the following letter he wrote in 1817:

"A method of ploughing over hill sides horizontally, introduced into the most hilly part of our country by Colo. T. M. Randolph, my son in law, may be worth mentioning to you. He has practiced it a dozen or 15 years, and it's advantages were so immediately observed that it has already become very general, and has entirely changed and renovated the face of our country. Every rain, before that, while it gave a temporary refreshment, did permanent evil by carrying off our soil: and fields were no sooner cleared than wasted. At present we may say that we lose none of our soil, the rain not absorbed in the moment of it's fall being retained in the hollows between the beds until it can be absorbed."

He was much interested in all kinds of crops, both garden and field, but particularly soil-improvement crops, such as clovers and other legumes. The latter he seemed to value more for their soil-improving properties than for feeding livestock.

Most of Jefferson's interest in livestock seems to have been centered in sheep and dogs. He had draft animals to be sure and some of these were oxen. He must have had milk cows to furnish milk, butter, and cheese for his many farm households, but we find nothing in his letters or reports to indicate what breed they may have been or how much milk they may have produced.

His special interest in sheep is indicated in a letter to President Madison, who was also a sheep enthusiast. He suggested that they give all their full-blooded males to the different counties throughout the State, as fast as they could furnish them. He thought this would encourage the formation in each county of small societies to maintain and provide rules for the use of the rams. That would seem to indicate that Jefferson was thinking about something similar to our present-day breeding circuits.

Jefferson's interest in dairy matters is also apparent in his notes and letters. In his account of a journey from Paris to the southern parts of France and northern Italy in 1787, he devotes considerable space to his observations on the making of butter and cheese. Years later in a letter to the editor of the *American Farmer* he recounted some of his observations on the making of Parmesan cheese at a dairy at Rozzano, which he says he "attended from sun-rise to sun-set, made short notes on the spot of what was passing under my eye, and when I returned to my lodgings at Milan at night, I wrote them at full length."

There in the stables he "saw 85 cows, fed on hay and grass, not on grain." He wrote that the milk was "scummed" and that butter was made from the cream, and cheese from the scummed milk. He recorded the day's operation in great detail, even such details as the fact that a quarter of an ounce of saffron was used to give color to the cheese.

When the cheese was made, the whey was put back in the kettle and the buttermilk was added also. From this they made a poor cheese for the

country people, and the whey from this was given to the hogs. Eight men, he said, "suffice to keep the cows and do all the business of the dairy."

I mention this to show that Jefferson after all was quite interested in dairying and no doubt had home-made cheese and butter in his own larder throughout the year.

But perhaps Jefferson's most famous dairy experience was in connection with the mammoth cheese that was presented to him at the White House on New Year's Day, 1802, by Elder John Leland of Massachusetts.

Elder John Leland was born and grew up in Massachusetts, but in 1778 he moved to Orange County, Va., not far distant from Jefferson's home. A strong friendship was formed between the two men. After 14 years in Virginia Leland returned to Massachusetts with his family and settled in an agricultural community near Cheshire.

Here Elder Leland helped by sermon and otherwise to promote the general acceptance of Jeffersonian principles and when Jefferson was elected President, Leland conceived a plan of celebrating his hero's election by presenting him with a cheese made from the milk of every cow within the precincts of Cheshire. On a specified day, July 20, 1801, curd was brought in from all the Cheshire farmers (excluding the Federalists) and a cheese was made that was 4 feet in diameter and 18 inches high, and that weighed 1,235 pounds. A cider mill was used for a press. The cheese was in the press 11 days, after which it was stored in a curing room until ready to be shipped to Washington.

In accepting the gift President Jefferson stated that he looked upon this New Year's gift as a token of the fidelity of the people of the country to the great cause of equal rights to all men, that he would cause the event to be placed upon the archives of the Nation, and that he would ever esteem it as one of the happiest occasions of his life.

The news of this event spread throughout the country and Elder John Leland became more famous than ever. A certain Federalist is said to have asked Elder: "Is it true that President Jefferson found some skippers in the cheese when he cut it?" The reply was, "It is quite possible, for although we tried to exclude all Federalists we learned afterwards that one or two got by us and some of their curds may have contaminated the cheese."

If Jefferson were alive today, I have no doubt but that he would be the owner of a herd of well-bred, registered dairy cattle. He would have the best of equipment on his dairy farm and would practice the kind of dairy husbandry that would lead to improvement in the efficiency of his animals, in the fertility of his fields, and the production of farm products of the highest quality. The records of his interests and achievements all point in that direction. He was also interested in forming agricultural societies, for mutual aid and study of technical problems. It is my feeling, therefore, that he would heartily approve of the work our American Dairy Science Association is doing and might even be a member of the Association.

EXTENSION SECTION

E1. Dairy Herd Improvement Association Organization and Agreement Forms. W. T. CRANDALL, *Cornell University, Ithaca, N. Y.*

Early in this war it was apparent in New York that counties were most successful in maintaining D. H. I. A. work when their testing work was organized on a county wide or district basis. Some counties with independently organized associations found it desirable to reorganize under the centralized plan in order to: (1) Rearrange routes to reduce travel of supervisors. (2) Arrange for smaller circuits to be tested by part-time supervisors. (3) Shift supervisors from one circuit to another to prevent the loss of two consecutive months' records in any one herd. (4) Combine any circuit losing its supervisor, with some other circuit for bi-monthly testing until a new supervisor can be obtained. (5) Give greater consideration to herds carrying on long-time breeding programs and H. I. R. tests.

It is important in a centrally organized county or district association that directors be chosen so that each circuit will have active representation. Each circuit should maintain separate identity in the reporting and summarization of its records.

It is suggested that any group of D. H. I. A. members be considered a circuit when it tests regularly with a full-time supervisor; or when it tests with a part-time supervisor with less than a full membership either because of geographical location, inability to get a full membership or the use of one or more supervisors who can devote only part time to association testing.

Agreements outlining the responsibilities of dairy herd improvement association members and supervisors in carrying on the business and work of D. H. I. A. testing are not legally binding and should not use legal and formal language. Such agreements are worth while in outlining the obligations and full responsibilities of the supervisor, the members and the organization.

Agreements should be simple but definite in statement of duties, so that there can be no misunderstanding on the part of either the supervisor, the member or the officers as to the purpose of the work or as to what must be done to accomplish that purpose.

E2. Short Cuts in Record Keeping. J. F. KENDRICK, *Dairy Bureau, U. S. Department of Agriculture, Washington, D. C.*

The present method of obtaining, calculating, and recording feed and production records in dairy herd improvement associations involves a great amount of detail record work, and in some instances duplication of work, to obtain data now required in the complete D. H. I. A. program. Perhaps some of the detailed work and most of the duplication of work may be reduced or eliminated without affecting the reliability of the records or their usability in the D. H. I. A. program.

With manpower at a premium, it is appropriate that the record-keeping methods of dairy herd improvement associations be critically analyzed to determine if the methods now in use can be streamlined to simplify the record-keeping work and thereby reduce the time required of association supervisors to obtain satisfactory records.

Some States have devised new methods of calculating production records and others have developed simplified record-keeping forms, all conforming with the basic rules governing association testing, which reduce the time required for the association supervisor to obtain and record satisfactory data. These developments should be reviewed and studied to determine if any of the methods developed should be adopted generally.

The record-keeping forms now in general use in associations have evolved through periodic revision of old forms to serve new phases of association work as they were developed and added to the program. It is appropriate to review as a whole all record-keeping forms now in use and explore the possibility of developing entirely new and simplified forms incorporating all the improved features that have been developed that are sound and practical for general use to serve the overall dairy herd improvement program as it is now conducted.

E4. Securing Supervisors During and Immediately Following the War.

C. R. GEARHART, *Pennsylvania State College, State College, Pa.*

The securing of D. H. I. A. supervisors seems to be as difficult, if not more so than it was in the fall of 1942. This is due to the drive made by Selective Service for more men in the Armed Forces. Practically no deferments for men under 26 and very few for those over 26 are being granted. Our difficulties are increased by Selective Service rescinding "Activity and Occupational" Bulletin No. 18, which listed D. H. I. A. supervisors among critical occupations. They are, however, still listed among essential occupations in "Activities and Occupational" Bulletin No. 5.

Many Draft Boards are somewhat confused as to their right to defer supervisors even though they feel that such action is justified. Deferring supervisors does not always solve our problem. Over half of the men that are deferred cannot stand the remarks, and insinuations that are often made, and enlist in the Armed Forces. The securing of cars, tires, and gasoline add to the difficulties of securing supervisors, but are minor factors compared to the loss of supervisors to the Armed Forces.

With these facts in mind, I shall review past methods used in securing supervisors, and recommend one or two new ones. In Volume 25, No. 8, issue of the Journal of Dairy Science are a few suggestions made in 1942, namely, "Maintaining Qualified Tester Personnel," by A. J. Cramer, "Supervisory Problems," by H. E. Loveland, "Emergency Adjustment in D. H. I. A. Procedure," by C. R. Gearhart, "Current Developments Affect-

ing D. H. I. A. Work," by Joseph B. Parker. The key thought in all of these briefs is the securing and maintaining of D. H. I. A. supervisors.

Some suggestions were made that did not prove practical, such as the use of local dairymen, 4-H Club members and Vocational Agriculture students who had not taken a short course, to keep the work going until a regular tester could be secured.

In 1943, Volume 26, No. 8 issue of the JOURNAL OF DAIRY SCIENCE, we again find four papers, the central thought of which is ways and means of keeping D. H. I. A. work going after the regular supervisor leaves. Page 719—"The Use of Conscientious Objectors as Dairy Herd Improvement Association Supervisors," by C. R. Gearhart. Page 721—"Vocational Agriculture and Junior D. H. I. Associations in War-time D. H. I. A. Adjustments," by R. F. Evans. Page 722—"Bi-Monthly Testing as a War-time D. H. I. A. Adjustment," by E. C. Scheidenhelm. Page 723—"Combining Associations," by Floyd J. Arnold.

Securing and holding supervisors. This past year, every effort was made to locate and train qualified men and women for D. H. I. A. positions.

Short courses were given every two months. We have used newspaper articles, radio talks, and personal letters to locate testers.

Special notices were sent to county agricultural agents and vocational agricultural teachers.

The Draft Boards have assisted in locating men placed in 4-F and yet we have less than a dozen 4-F supervisors in the field.

The State U. S. Employment office has offered their assistance, and two supervisors from that source are now in the field.

Our attempts to interest men over draft age have been rather unsuccessful. We have secured only three such men during the past two years. The change of beds and diet seems to be the main objection of men in the over-age group.

We have fourteen girls working now, with only one or two prospects for getting more. We are well pleased with their work. It is usually neater and just as accurate as that done by the men. Since December, 1941, there were 23 girls hired by associations, nine of whom have resigned. Moving to different farms over some roads that are not too good, and in all kinds of weather is the main objection of the average girl.

A number of our testers are under draft age, but it is too much to expect these boys to conduct the work as it should be done. All they can do is keep the most fundamental records.

We have forty-one conscientious objectors, who are doing excellent work. Most C. P. S. men take an interest in their work even though they receive no financial reimbursement. They are courteous and trustworthy, and are respected by their dairymen. Of the forty-one, I do not know of one that uses tobacco, liquor or profane language. As one dairyman put it, "We

appreciate the absence of profanity, unclean stories, etc., which might influence our children."

During 1943, we were able to keep the old associations supplied with testers practically 100 per cent. In only a few cases was it necessary to resort to cooperative testing, that is one association loaning their supervisor—one month at a time—to neighboring associations. In a few cases, the association losing their supervisor was allowed to miss one month and that month averaged by using the preceding and succeeding months' records.

New source of supervisors. The only new source of securing supervisors is discharged soldiers.

Work was started on this nine months ago, with a willingness to cooperate all the way from Washington, D. C., down to the county organizations. Since starting on this project, personnel and channels have been changed, making it difficult to know just what contact to make.

A hoped for plan. To make the project practical, I feel there should be one person who has contact with soldiers as they are being discharged and who knows about the need and qualifications of supervisors. When he finds men interested, he can direct them to get in touch with the county agricultural agent located in his home county.

He should be in a position to put out information relative to the needs and qualifications of supervisors. When he finds a soldier interested, check on his qualifications, and keep in touch with him until he has been discharged and arrangements have been made for his attending a D. H. I. A. Short Course.

Present plan. At present we are keeping in touch with State Headquarters of Selective Service Re-employment Division; The Veterans Employment Division; and the U. S. Employment Service; all located at Harrisburg, Pennsylvania, the State Capital.

Through the State U. S. Employment Service, we have sent a letter to the 91 local offices, scattered throughout the state. This letter stated the qualifications of a supervisor and requested that the local representative of the U. S. Employment Service get in touch with the local county agricultural agent, when finding a prospect.

So far we have obtained only 2 discharged soldiers.

E5. Streamlined Testing for Dairymen. *Department of Dairy Husbandry, University of Wisconsin, Madison, Wis.*

In 1941 a study was made of D. H. I. A. programs in California and Washington to ascertain the adaptability of central laboratory testing to Wisconsin conditions. Two county-wide cooperative associations were organized that year. The advantages of this system of testing soon led to the organization of other associations. Under the conditions imposed by the

war, great development of this testing program is under way in this state. At present 28 County Cooperative D. H. I. A.'s are organized or in operation.

The principal advantages of the program are: (1) Provides any type of testing service desired by any dairyman in the county—A. R., H. I. R., D. H. I. A. Standard, or Owner-Sampler. (2) Permits testing 10 to 20 per cent of all cows in any county at all times. (3) Provides sufficient income to pay testers much more satisfactory salaries, plus travel. (4) Central laboratory facilities contribute toward more accurate records with less inconvenience to herd owners. (5) Program is conducted as a business governed by the Cooperative Laws of the state.

E6. Testing in Areas of Small Herds and Scarce Membership. R. A. CAVE, *South Dakota State College, Brookings, S. Dak.*

South Dakota represents an area as outlined in the topic for discussion. Since the writer is familiar with the dairy herd improvement work in that state he can best discuss the subject by describing the progress made.

The operation of dairy herd improvement associations in South Dakota has fluctuated widely since the first one was started in 1923. From that time until 1931 the number of associations increased to 14 with 340 herds and 5000 cows on test. This was a period of fairly good crops and relatively high prices for dairy products as compared to the prices of meat animals and feed crops. Interest in dairying was increasing and many dairy heifers were imported from Wisconsin and Minnesota for 4-H dairy club members.

The depression and several years of severe drought in the early thirties was disastrous to all livestock production and by the spring of 1936 had reduced the volume of testing to two associations containing 18 herds and 440 cows. In spite of the relatively unfavorable prices for dairy products as compared to meat animals since 1936, the associations were increased to eight with 150 herds and about 3000 cows by 1941. In 1942 and '43 all of the supervisors were either deferred for agriculture or inducted into the armed forces.

At the present time we have three associations containing about 45 herds, operated by two supervisors. One is 60 years old and the other 70. They are both interested in their jobs and are doing satisfactory work. They tend to business and do not run around nights. The 60-year-old supervisor operates one association of 18 members on a monthly basis and another of 13 members on a bi-monthly basis. We have not attempted to hire women or girls as supervisors because of the long distances to travel and the sentiment against it.

Continuous operation of dairy herd improvement associations in South Dakota is confronted with many obstacles.

There is a lack of interest because of a cash grain farming background and an antipathy toward milking cows and doing chores.

Large farms averaging about 500 acres cause crop raising and livestock, other than dairy, to compete very strongly with the dairy enterprise for the time and attention of the farm operator.

There is much shifting back and forth between dairying and meat animal production as the relative prices for those products change.

The number of cows per head has averaged about 14 since the associations were first started.

Cows are milked and cream or milk sold from about 85 per cent of the farms in the state. The dairy enterprise, however, is secondary on a large per cent of the farms and the owners who desire to join a dairy herd improvement association are few and far between.

It is often necessary to combine the interested dairymen of three or four counties in order to have a sufficient number to make a full association. The supervisor's route sometimes covers 300 miles or more. The holding of meetings, to attend to the business of the association and discuss dairy problems, is very difficult. It is also hard to maintain membership so the supervisor will have full-time work.

Whenever a group of dairymen is interested in organizing a D. H. I. A. they are given all the assistance possible by the extension dairyman and county agricultural agent. The cooperative creamery or other marketing agency is usually interested and will help compile a list of dairymen as prospective members. These dairymen are contacted personally, by letter, or at called meetings. A personal interview, by an interested dairyman, the county agricultural agent, or the county agricultural agent and extension dairyman, is usually most successful in obtaining members. Excuses for not joining are legion but when analyzed usually mean that the herd owner objects to an action program.

If enough members for a full association cannot be obtained in one county, dairymen in adjacent counties are solicited. A meeting is then called by the county agricultural agent for organization. At this meeting a board of directors is elected which selects its own officers consisting of president, vice-president and secretary-treasurer.

The fees for testing are agreed upon and consist of a flat rate for herds of 10 cows or less plus 10 cents per cow above 10.

Candidates for the position of supervisor are presented, when possible, by the extension dairyman and selected by a vote of the directors. The supervisor is given several days of training at the state college or trained right on the job by the extension dairyman.

Supervisors are paid by each member at the time each herd is tested. The amount of his pay depends upon the number and size of the herds in the association. In some instances monthly dues of 10 cents per member

are collected by the supervisor and turned over to the treasurer of the association. After the supervisor becomes acquainted, he assumes some responsibility in keeping up the membership.

The membership agreements provide for one year of testing. They contain a clause requiring members, who withdraw during the year, to pay the testing fees for the entire year or get a substitute who is satisfactory to the board of directors. No attempt has ever been made to enforce this provision in the agreement. When members drop out, thus, cutting down on the income as well as the time of the supervisor; the county agricultural agent, officers, supervisor, and sometimes the extension dairyman make every effort to get new members. Small associations with part-time supervisors have not been very satisfactory as the testing is likely to be irregular. In one instance the advanced registry work at two state institutions was combined with eight regular D. H. I. A. herds and worked out quite satisfactorily.

After an association has been in operation a few years new members have joined at irregular intervals and the close of the testing year is not the same for all herds. Since there is no date for stopping operation without leaving some herds with incomplete yearly records, the tendency is toward continuous operation of the association except when the supervisor is lost. Annual meetings are held if possible to elect officers, discuss dairy problems, get acquainted and plan the program for the year.

A summary of the herd records is compiled each month from the supervisor's monthly report to the extension dairyman. This summary also contains news items and timely discussions of subject matter. It is mailed to each member, and to a mailing list of former members and county agents, under stamp.

In South Dakota the dairy herd improvement association is looked upon as the most effective means of raising the efficiency of the dairy herds. Every effort will be made to keep them alive and functioning to the fullest extent possible.

E7. Wartime 4-H Dairy Club Program. J. C. NAGEOTTE, *Pennsylvania State College, State College, Pa.*

Before the war our dairy 4-H program included the careful selection of calves, group meetings at which we gave instructions in feeding, fitting, and management. This was followed by a round-up at the end of the year when all the calves were exhibited and the club members were scored on the type, fitting, showing, and record book of their project.

War restrictions on travel, and shortage of farm labor made it seem too impractical to carry on the former program. We were forced to decide whether we should curtail our program; or change our method of conducting this project. Increased demand for calf club work helped us to decide to modify our method of conducting the work.

Instructions on care and management had been incorporated in the club record book, and by frequent new editions we have been able to keep this up to date. This made it possible to eliminate part of the meetings.

The selection of the calves we have left in the hands of the parents and local county agents. The quality of calves hasn't been too bad as a result of this practice; but we feel this change has not been for the best. More time is needed to see the results in the selection of calves.

The most drastic change was the elimination of the round-up at the close of the club year as a means of measuring the quality of the club work. We have substituted for this a scoring system which is designed to measure how effectively the club members apply the instructions given them on feeding and care of calves. This scoring is done in the club member's barn.

There are two score sheets used, one for first-year members, and one for second-year members. (Copies of these sheets will be available for distribution.) The first-year score is based on the selection of the calf, breeding and type, the feeding program, housing and management, training and fitting, record books, and attendance at club meetings.

The second-year score includes the following headings: The breeding program followed, type, feeding, stabling, growth, training and fitting, record books, and attendance at club meetings.

Club members receiving a score of 90 points or more receive a blue ribbon; 80 to 89, a red ribbon; 70 to 79, a white ribbon. Any receiving a score below 70 are awarded no ribbons, but are credited with a completion.

The scoring is done by a Dairy Specialist or a county agricultural agent. We find that fewer blue ribbons are awarded than were at the round-ups. A few scores went over 100, but most fall between 70 and 89. There were as many below 70 as there were over 100. We also found we were scoring the parents as much or more than we were the club members. The parents found this out too, and the results have been most encouraging in getting a good calf-raising program established on these farms. If calf-club work is to be a worthwhile project it must improve practices of our farms. This scoring system has decidedly helped do this.

The trend this year is to have more calf-club shows, not round-ups; with the farm score used to measure the quality of the club work and the award to be given. We doubt if we will give up the scoring system and go back to the old type round-up after the war. However, we feel that a calf-club show for those who are interested in showing is necessary; but we should have some other form of completing the project for those who do not care to, or cannot show.

E8. The Forced Ventilation System of Curing Hay in the Mow. R. G. CONNELLY, *Virginia Polytechnic Institute, Blacksburg, Va.*

The types of forage plants, the cultural practices followed in their production, and the methods used in harvesting, curing and storaging hay crops

largely determine the feeding qualities and milk production value of the hay. The forced ventilation system of curing hay offers several possibilities as a practical method for saving hay crops, for conserving practically all the plant leaves and a large percentage of green color; and for providing a more palatable hay of higher protein content for dairy cattle.

The "Mow Hay Drier" consists of a series of air ducts built on the floor of the hay mow. Is is designed so that a large volume of air, under low pressure (at least 10 cu. ft. per minute) can be distributed uniformly throughout the duct system. The air pressure is maintained by a motor-driven, multivane fan. The single system has a central air duct that tapers from the fan housing at one end of the mow, down the center line on the mow floor to the opposite end of the mow. Smaller lateral ducts, spaced at 4- to 5-foot intervals, extend at right angles from both sides of the main central duct, to within 5 feet of the walls of the mow. The central duct is sealed, except for the vents that lead into the lateral ducts, which resemble inverted wood troughs, blocked up one inch from the mow floor to permit the uniform escape of air into the hay deposited on the duct system.

Hay cured properly in the mow by forced ventilation is superior to hay from the same cutting cured in the field.

When samples of mow- and field-cured hay from the same cutting were inspected by U. S. Department of Agriculture hay grades, the mow-cured samples were graded consistently one to two grades higher than the field-cured hay.

Samples of mow-cured alfalfa hay, leafy, green, showing less than $\frac{1}{4}$ bloom, from the 1943 crop, taken in March and April, 1944, from mows on five different Virginia dairy herd improvement association farms, analyzed 92 to 93 per cent dry matter; 3.23 to 3.75 per cent nitrogen, or 20.19 to 23.44 per cent crude protein on a calculated basis. One especially leafy, green sample of mow-cured alfalfa hay, still showing purple color in the bloom, was taken from the mow on a sixth Virginia dairy farm. This sample analyzed 92 per cent dry matter; 4.39 per cent nitrogen, and 27.44 per cent crude protein on a calculated basis.

The alfalfa hay cured by forced ventilation on the above five Virginia dairy herd improvement association farms was fed to the respective farm dairy herds. Under the practical conditions maintained on these farms, the average monthly milk production per cow for the five- to seven-month period when mow-cured hay was fed was consistently greater than the average monthly milk production per cow for the comparable five to seven months of the previous year when field-cured hay was fed.

The cows in Herd No. I averaged 536 pounds of milk per month on field-cured hay in the 1941 hay-feeding period, and 644 pounds of milk, and 615 pounds of milk per month on mow-cured hay in the comparable 1942 and 1943 hay-feeding periods, respectively. In Herd No. II the cows averaged

676 pounds of milk per month on field-cured hay in 1941; fed mow-cured hay they averaged 681 pounds, and 698 pounds milk production in 1942 and 1943, respectively. The average monthly milk production per cow in Herd No. III was 570 pounds for the months in 1941 when the herd was fed field-cured hay; and 623 pounds, and 610 pounds per month for the comparable periods in which they were fed mow-cured hay in 1942 and 1943, respectively. In Herd No. IV the cows averaged 673 pounds of milk per month on field-cured hay in 1942, and 757 pounds of milk on mow-cured hay in 1943. The cows in Herd No. V averaged 909 pounds of milk on field-cured hay in 1942, and 1040 pounds per cow on mow-cured hay during the comparable hay-feeding period of 1943. All herds were milked twice daily. Silage was fed with the hay. The grain supplement, containing approximately 13 per cent crude protein in Herd No. V, and 14 to 18 per cent crude protein in the other four herds, was fed by weight according to milk production.

E11. Action Program for Rapid Washing Method. J. M. JENSEN, *Michigan State College, East Lansing, Mich.*

Considerable attention has been given to a field program involving practical rapid methods of washing dairy utensils and utilizing wetting agents and sodium hexametaphosphate as detergents.

The rapid "flush" methods of washing separators and milking machines were tried and found to be highly satisfactory, after which the procedure was presented to inspectors, sanitarians and county agricultural agents before being taken to the field in form of demonstration meetings.

Unusual interest was shown by audiences in these demonstrations. As a result of 32 meetings attended by 1,300 persons more than 100,000 pounds of wetting agent detergent alone was reported sold in the first six months after its initiation in lower Michigan.

PRODUCTION SECTION

P1. Some Factors Affecting the Nutritive Value of Korean Lespedeza Hay.* H. A. HERMAN, E. W. SWANSON AND A. C. RAGSDALE, *University of Missouri, Columbia, Mo.*

Digestion trials with growing dairy heifers have indicated a wide variation in the nutritive value of Korean lespedeza hays. Routine chemical analyses have been found to give a poor index of the nutritive value of the hay because of the characteristic tendency of Korean lespedeza to contain large amounts of lignin. This plant generally contains about 50 per cent more lignin than alfalfa. Typical samples were found to contain 17 per cent lignin in the stems and 23 per cent in the leaves, whereas in alfalfa the stems are about twice as high in lignin as the leaves.

* Contribution from the Department of Dairy Husbandry, Missouri Agricultural Experiment Station, Journal Series No. 950.

Digestion trials with 12 growing Holstein heifers fed Korean lespedeza cut at various stages of growth indicate a decrease in total digestible nutrients with increasing lignin content and advancing maturity of the plant. Korean lespedeza cut for hay at an early to intermediate stage of growth contained 52.03 per cent total digestible nutrients, whereas the late-cut hay contained an average of only 37.9 per cent. Early-cut hay contained about 15 per cent and late-cut from 19.9 to 23 per cent lignin. Holstein heifers weighing an average of 800 pounds, and fed 2 pounds daily of the late-cut lespedeza hay per hundredweight, were unable to make gains in nitrogen storage and were occasionally in a negative balance. Since we have found mature, highly lignified, Korean lespedeza hay to be of lower nutritive value, it tends to further explain the deleterious effects on milk production where dairy cows are forced to consume large quantities of such hays. Early-cut or immature Korean lespedeza is comparable in nutrient content to alfalfa hay, but unfortunately much of it is harvested at a stage too mature for good quality hay of highest feed value.

P2. The Feeding Value of Cheat for Dairy Cows.* M. H. Berry, K. L. Turk, and L. A. Moore, *University of Maryland, College Park, Md.*

Two feeding trials were conducted for the purpose of determining the feeding value of ground cheat (*Bromus secalinus*) as compared with ground barley when fed as 30 per cent of a grain ration for milking cows. In Trial I, two groups of six milking cows were fed on a double reversal trial for three six-week periods. In the second trial, two groups of five milking cows were fed on a double reversal trial for two six-week periods and for one four-week period because an insufficient amount of cheat was available to carry the cows to the end of the regular period.

The only variant in the ration fed to both groups in both trials was the substitution of cheat for an equal amount of barley in the grain mixture. Grain was fed according to milk production, allowing one pound for every three pounds of 4 per cent fat-corrected milk. Alfalfa hay was fed at the rate of one pound per day and corn silage at the rate of three pounds per day for each 100 pounds of live weight.

In the first trial, the cows on the cheat mixture averaged 27.2 pounds of milk and 1.3 pounds of butterfat daily with an average per cent fat of 4.8. The cows fed the barley mixture averaged 26.7 pounds of milk and 1.3 pounds of butterfat daily with an average per cent fat of 4.7. When the milk produced by each group was converted to 4 per cent fat-corrected milk, the cows on the cheat mixture averaged 30.1 pounds and the cows on the check or barley ration averaged 29.6 pounds daily.

There was no significant difference in the feed consumption of the two groups. The average change in live weight per cow per week for the trial

* Scientific Article A85a, Contribution No. 1942 of the Maryland Agricultural Experiment Station (Department of Dairy Husbandry).

was also insignificant. The cows on the barley mixture lost an average of 1.2 pounds and those on the cheat mixture lost an average of 2.2 pounds per cow per week for the entire experimental period.

In Trial II, approximately the same results were secured as were in Trial I. The cows fed the cheat mixture averaged 25.9 pounds of milk and 1.1 pounds of butterfat daily with an average per cent fat of 4.3. The cows fed the barley mixture averaged 25.2 pounds of milk and 1.2 pounds of butterfat daily with an average per cent fat of 4.8. When the milk produced by each group was equated to its equivalent value in 4.0 per cent fat-corrected milk, the cows on the cheat mixture averaged 27.4 pounds of milk and the cows on the barley ration, 28.1 pounds of milk daily.

In this trial as in Trial I, there was no significant difference in the feed consumption of the two groups. In Trial II, the cows on the cheat mixture maintained their weight at a very slightly higher level throughout the trial. The cows on the cheat mixture made an average weekly gain of 4.6 pounds per cow and those on the barley mixture 4.1 pounds per cow per week.

The average composition of the cheat fed in these trials was as follows: 8.60 per cent water, 12.36 per cent protein, 2.13 per cent fat, 8.14 per cent fiber, 2.95 per cent ash, and 65.84 per cent nitrogen-free extract.

The average composition of the barley fed in these trials was as follows: 10.95 per cent water, 12.75 per cent protein, 2.24 per cent fat, 5.33 per cent fiber, 2.30 per cent ash, and 66.45 per cent nitrogen-free extract.

The results obtained in these two feeding trials with dairy cows show cheat to be equal to barley in feeding value for milk production. Chemical analyses of the cheat and barley fed in both trials showed cheat to be practically the same as barley in composition.

P3. Invisible or Fermentation Losses in Silage Making. A. E. PERKINS, *Ohio Agricultural Experiment Station, Wooster, Ohio.*

Certain losses encountered in silage making, such as leakage of juice or top spoilage, are obvious and with ordinary methods may be determined if desired. These losses, moreover, may with proper care be largely or entirely avoided.

Another type of loss which occurs in the ensiled mass cannot be so readily detected or avoided. Water and gases are formed as by-products of chemical or fermentative reactions, some of which escape or are of no further nutritive value. The exact extent of this type of loss is not well known and is not readily measurable. The total loss of weight of the ensiled material when evaporation is avoided gives a rough measure of the "Fermentation loss."

Work with a series of small experimental silos is reported in which the invisible or fermentation loss is determined by the "total loss of weight" method. One series of 49 such observations previously reported gave an

average loss of 4.18 per cent. The loss seemed to be greater with some crops than with others. A series of 62 observations during the 1943 season gave an average loss of 3.56 per cent. Both these values are probably too high because of imperfectly controlled evaporation.

These values are, nevertheless, in decided contrast to those in the neighborhood of 15–20 per cent which have often been reported, especially when procedures which involve the drying of samples of the silage are employed. A parallel series of water determinations on 68 samples of silage by oven drying and by a distillation technic showed an average difference of 2.05 per cent on the fresh basis, equivalent to 8.95 per cent dry basis. Dry matter, if taken as 100 per cent minus the water, would vary to the same extent in reverse order of magnitude.

This would account for a major part of the discrepancy in results between ensiling losses obtained by the total-weight-loss method and others obtained by procedures which involve oven drying of silage samples.

P5. Effect of Feeding Corn and Alfalfa Silages on the Fat-and-Water-Soluble Vitamins of Winter Milk. J. J. STEFANIAK, I. W. RUPEL, AND W. H. PETERSON, *University of Wisconsin, Madison, Wis.*

Carotene and vitamin A. An experiment to determine whether a corn silage high in carotene would approach an alfalfa silage in maintaining a high level of carotene and vitamin A in the milk was conducted with 3 lots of milking cows. Lot I received corn silage; lot II, equal amounts of corn and alfalfa silages; and lot III, alfalfa silage. Besides silage, all lots were fed a good grade of alfalfa hay and a grain ration adjusted to correspond to the butter-fat production. Each lot consisted of five cows selected so that lactation and butter-fat production were approximately equal. The feeding period began on November 10th and ended on February 10th.

Milk production for the three lots at the beginning of the trial and at the end of the 8th week was as follows (lbs. 4% milk per cow daily): lot I, 29.8, 24.7; lot II, 29.8, 22.1; lot III, 29.2, 22.5.

While the carotene and vitamin A contents of the milks increased with the intake of carotene in the ration, this increase was not directly proportional to the intake. From silage, lot I received 289 mg. of carotene per cow per day, lot II, 664 mg., and lot III 1,039 mg. From the alfalfa hay, about 125 mg. additional carotene per cow per day was ingested. Carotene and vitamin A of the milk expressed as micrograms per gm. of butterfat were: lot I, 4.58 carotene and 5.56 vitamin A; lot II, 5.39 and 5.89; lot III, 5.74 and 6.94. These data show that the corn silage was almost equal to the alfalfa silage in maintaining the carotene and vitamin A contents of the milk.

Three B vitamins. During two preceding years, the effect of feeding several different types of silage for about 10 weeks on the contents of panto-

thenic acid, niacin and biotin of the milk was tested. The average figures per ml. of milk were as follows: corn silage, 3.8 micrograms pantothenic acid, 0.69 micrograms niacin and 28 millimicrograms biotin; corresponding figures for soybean-sorghum silage were 4.9, 0.65 and 46; the values for alfalfa silage were 4.1, 0.60 and 49.

Biotin was the only one of the three vitamins which varied significantly with the forage fed. Milk from cows fed soybean-sorghum and alfalfa silages contained about 50 per cent more biotin than that from corn silage.

P6. A New Feeding Standard for Milk Production. T. A. BAKER, *University of Delaware, Newark, Del.*

At the Delaware Agricultural Experiment Station five groups of Holstein cows were fed for two consecutive lactations at different levels of total digestible nutrients. The actual levels above maintenance requirements as calculated at the end of the experiment were 82.2, 98.0, 105.3, 122.4, and 131.0 per cent of the Haecker standard.

The addition of a pound of T.D.N. gave as great an increase in milk production at the higher levels as at the lower. The average return from the addition of a pound of T.D.N. to the ration was 1.46 lbs. of 4 per cent fat-corrected milk.

It is recommended that the feeding standard for milk production be raised 20 per cent above the Haecker standard.

P7. Limited-Grain Ration vs. All-Roughage Ration for Dairy Cattle. F. B. WOLBERG, A. A. SPIELMAN, V. L. MILLER, AND U. S. ASHWORTH, *State College of Washington, Pullman, Wash.*

At one year of age one group of Holstein heifers was placed on an all-roughage ration consisting of pasture, hay and silage. The other heifers receive similar roughage plus a limited amount of grain, 1.5 to 2 pounds daily during winter only. All the animals are kept in the herd throughout their productive life. During lactation the limited-grain group receives one pound of grain for each eight pounds of milk produced.

Data are presented on the first eight years of this study. Thirty-five heifers in the limited-grain group and 28 in the all-roughage group have been raised from one year of age to calving. The average age at calving was 29.8 months for the limited-grain group, and 30 months for the all-roughage group. The average total digestible nutrients consumption per 100 pounds gain in live weight for heifers not receiving grain was 1386 pounds, and for heifers receiving grain, 1309 pounds. The average gain in height and body weight during a period of 540 days was 16.9 centimeters and 491.8 pounds for the all-roughage heifers.

The number of completed lactations to date for each group is as follows: limited-grain group, first lactation 23, second lactation 13, third lactation 11,

fourth lactation 5; all-roughage group, first lactation 24, second lactation 15, third lactation 10, fourth lactation 4. The average production of FCM was 10,444 pounds for the all-roughage group and 7,941 pounds for the limited-grain group. The gross efficiency of the two groups as indicated by the FCM/TDN ratio is in favor of the grain group with a ratio of 1.47 as compared to a ratio of 1.38 for the all-roughage group.

The average number of services per conception was 3.11 for the grain group and 3.34 for the all-roughage group.

P9. Carotene Losses in Freshly Cut Plant Tissues. R. K. WAUGH, S. M. HAUGE, AND J. H. HILTON, *Purdue University, West Lafayette, Ind.*

Green plant materials with high carotene content often contain small amounts of carotene after they have been made into hay. This loss is probably due to enzymic action. Previous investigations indicate that the retention of carotene in some plant materials is greater than in others.

During the past year studies have been made to determine the losses of carotene in various types of freshly cut plant material. In these tests it was found that the destruction of carotene, due to enzymatic activity, was greater in alfalfa, red clover and sweet clover than in the oat plant, Kentucky bluegrass and bromegrass. Other plants, such as corn, soybeans, and lespedeza, seem to have an intermediate enzyme activity.

P10. Vitamin A Requrements of Dairy Cattle for Normal Growth and Reproduction. J. H. HILTON, J. W. WILBUR, AND S. M. HAUGE, *Purdue University, West Lafayette, Ind.*

Studies have been in progress for several years to determine the vitamin A requirements of dairy cattle for normal growth and reproduction. Two groups of 60-day-old heifers were fed a vitamin-A-deficient ration until their body stores had been depleted, after which one group was fed 7,500 I.U of vitamin A and the other group 15,000 I.U. of vitamin A daily. The source of vitamin A was a concentrate from fish-liver oil. These heifers were continued on these levels from approximately five month of age through the first gestation. Heifers of both groups grew satisfactorily.

Although these levels were adequate for growth they were inadequate for normal reproduction. Of the heifers on the 7,500-unit level, one failed to conceive and the other dropped a dead calf prematurely. Autopsy of the calf showed marked degeneration of the nervous system. Both heifers on the 15,000-unit level, likewise, dropped premature calves which were abnormal, blind and died within 48 hours after birth. These calves also showed degeneration of the nervous system, but to a less extent than the calf from the heifer on the 7,500-vitamin-A-unit level.

During the second gestation the daily vitamin A intake of two of the heifers was increased from 15,000 units to 30,000 and 45,000 units, respec-

tively. Both heifers dropped normal calves at the end of normal gestation periods.

P11. Carotene Levels for Growth and Reproduction in Dairy Bulls. I. R. Jones and J. R. Haag, *Oregon State College, Corvallis, Oreg.*

A group of Jersey bulls was fed whole milk to 40 days, skimmilk to 90 days, and a calf meal in increasing amounts up to 3 pounds daily. Dried molasses beet pulp was fed ad libitum.

Two calves fed the basal ration only developed symptoms of vitamin-A deficiency in 6 to 8 weeks after whole-milk feeding was discontinued. The symptoms included diarrhea, eye disorders finally resulting in permanent blindness and eventually death. Blood plasma carotene values were usually of the order of 0.03 ppm.

Eight additional calves were divided into groups of 2 which respectively received alfalfa meal to supply carotene at the daily rate of 5, 20, 35, and 65 micrograms per kilogram of body weight.

Levels of 5 and 20 micrograms carotene per kilogram of body weight were not sufficient to prevent symptoms of vitamin-A deficiency, one calf dying and the other 3 becoming permanently blind. One of the latter dislocated a hip on falling and was destroyed. The carotene intakes of the other two calves, Nos. 51 and 55, were raised to 65 micrograms per kilogram of body weight at 236 and 184 days of age with the result that the bulls again began growing and the blood carotene values rose from around 0.06 to about 0.40 ppm. At 375 and 323 days of age the carotene intakes were reduced to 25 micrograms per kilogram, which has been sufficient for them to make normal growth and maintain blood carotene values of about 0.30 ppm. to their present ages of 556 and 504 days. Semen samples from the older bull No. 51 appear normal, and 3 females are probably pregnant to his service. Bull No. 55 has as yet not shown sexual desire, although other than being blind, he appears entirely normal.

The two bulls Nos. 52 and 59 fed 35 micrograms carotene per kilogram body weight have responded somewhat differently. No. 52 grew normally, had blood carotene values of 0.07 to 0.12 ppm. from 122 to 278 days of age at which time he suffered a convulsion in his pen and was found to be totally blind. No change was made in carotene intake. He has continued to grow normally and at 500 days had blood carotene value of 0.46 ppm. Semen samples appear normal. No. 59 has grown at an above normal rate, with the lowest blood carotene value 0.13 ppm. at 74 days of age and the present value about 0.50. Four females have been bred to him with two definitely pregnant after 1 and 3 services.

The two bulls Nos. 57 and 60 fed 65 micrograms carotene per kilogram of body weight have grown considerably faster than normal throughout the study without symptoms of vitamin-A deficiency. Blood carotene values

have gradually increased from about 0.2 to 0.4 ppm. as the animals have become older. Seven heifers have been bred to No. 57 with 3 probably pregnant. Four heifers have been bred to No. 60 with 2 pronounced pregnant.

P12. Changes in Blood-Plasma Carotene Associated with Parturition and Lactation of Jersey Cows. A. H. KUHLMAN AND W. D. GALLUP, *Oklahoma A. & M. College, Stillwater, Okla.*

Further investigation of changes in the carotene content of the blood plasma of Jerseys at parturition has provided results which are in good agreement with those previously reported by the authors. They are also in general agreement with the results obtained by Sutton and Soldner with Ayrshire, Guernsey and Holstein cows.

As in previous studies the experimental ration was composed of prairie hay, beet pulp, cottonseed hulls, cottonseed meal and minerals. Occasionally white hominy feed was included in the ration. Prairie hay in varying amounts was the source of carotene in the ration in all but a few instances when known amounts of carotene in the form of "Puratene" were given daily.

The carotene content of the hay was determined on composite daily samples at monthly intervals by Peterson's method. Plasma carotene determinations were made at monthly or more frequent intervals by colorimetric methods, the petroleum-ether soluble pigment being compared to potassium dichromate standards. Carotene determinations were made on butterfat samples of individual cows on the fifth day in lactation by the spectrophotometric procedure of Fraps.

Data which were secured from 63 calving records of 30 high-grade Jerseys showed that at parturition there was a decrease in plasma carotene in 52 cases, an increase in 9 cases and no change in 2 cases. The average plasma carotene values for the entire group were 169 micrograms per 100 ml. plasma before calving and 134 micrograms after calving. This is an average decrease of 21 per cent. These results when grouped according to the carotene intake of the individual cows before and after calving either as milligrams per day or as micrograms daily per pound body weight, showed the general decline in plasma carotene previous to and directly after calving for all groups. The percentage decrease in plasma carotene was directly related to the amount present previous to parturition; it was less closely related to carotene intake since some cows maintained relatively high plasma carotene values despite low intakes. For cows on low levels of carotene intake and having correspondingly low plasma carotene values, 70–72 micrograms per 100 ml. of plasma, the decrease in plasma carotene at calving was less than 2 per cent. When plasma carotene values were high, over 200 micrograms per 100 ml. of plasma, the decrease at calving time was over 30 per cent. Groups between these extremes showed intermediate values. At

present there seems to be no explanation for these changes in plasma carotene. They may be associated with milk secretion, absorption or storage, or with a more efficient conversion of carotene to vitamin A during a critical period.

There is apparently a rather definite relationship between the carotene content of the blood plasma after calving and the carotene content of the butterfat. Carotene values of the butterfat of milk produced on the fifth day in lactation were: 0.88, 1.51, 2.90 and 3.32 micrograms per gram of fat when the blood-plasma carotene values after calving were, respectively: 67, 114, 174 and 262 micrograms per ml. of plasma.

P13. Vitamin E in the Nutrition of Cattle. T. W. GULLICKSON, L. S. PALMER, W. L. BOYD, AND F. C. OLSON, *Minnesota Agricultural Experiment Station, St. Paul, Minn.*

This is a progress report and relates to a study started in 1938, the object being to determine the importance of vitamin E in the nutrition of cattle, especially in relation to reproduction. In 1940 we reported in regard to the vitamin-E potency of a considerable number of feedstuffs and also the methods of assaying used. The present report deals with the results obtained with cattle fed rations made up entirely of feeds devoid of vitamin E as determined by both bioassay and chemical tests.

A total of 22 animals, 15 females and 7 males, of various breeds have been used to date (including one female and one male fed alpha tocopherol as a supplement) for more or less extended periods of time. Records have been kept of growth, amount of feed fed, physical and sexual development and general well-being of each animal. Determinations have also been made at monthly intervals of the calcium and inorganic phosphorus and the ascorbic acid content of the blood plasma.

Growth and physical and sexual development in all cases have been normal. Of the eleven females of breeding age, including the check animal, ten have calved normally. The other heifer died suddenly from unknown causes about six weeks before she was due to calve; however, the fetus present was normal. All calves have been normal in size and very vigorous at birth. In only two of the eleven heifers represented was more than one service required for conception. The sire used in each case was raised on a vitamin-E-free ration. A considerable number of heifers were discontinued after calving and therefore little information is available in regard to second calvings.

The ascorbic acid content of the blood plasma of cattle on vitamin-E-free diets was similar to that of the check animals and those fed normal rations. Some of the vitamin E ingested by cattle fed normal rations was voided in their feces. None was found in the feces of those fed the vitamin-E-free rations. No detectable amount of vitamin E has been found in the tissues (liver, muscle, body fat, testes) of cattle fed the deficient rations.

P13a. The Value of Fat in Alfalfa Hay Rations. J. H. BYERS, V. R. SMITH, AND I. R. JONES, *Oregon State College, Corvallis, Oreg.*

Cows fed alfalfa hay supplemented with salt and disodium phosphate have produced in our herd only about 70 per cent as much fat-corrected milk as expected from the amount of total digestible nutrients consumed.

Experiments with six cows were conducted over a period of two years, during which various concentrates, including ground soybeans, skimmilk powder, sugar, fish meal, meat meal, blood meal, molasses beet pulp, dehydrated molasses, wheat bran, soybean meal, peanut meal, oat groats, and wheat middlings were fed over 4-week periods in comparison with periods of feeding on alfalfa hay supplemented only with salt and disodium phosphate. The decline in production when the cows received a ration of alfalfa hay alone, whether in early, middle, or late lactation, was practically always much more rapid than when part of the alfalfa hay was replaced by calculated equal amounts of total digestible nutrients in the various concentrates used. The production was particularly higher during the periods when soybeans were fed. Skimmilk powder seemed to be the next most efficient of the concentrates used.

The results with these various concentrates might indicate that the digestible nutrient system overrates the productive value of alfalfa hay when it constitutes the principal or sole source of nutrients other than minerals.

In order to check further the relationship between the fat content of the ration and the production of milk and butterfat, four additional cows were carried through complete lactations on rations of alfalfa hay and ground soybeans, alternated at 6-week intervals with alfalfa hay and soybean meal. The average fat content of the dry matter of the ration was 5.12 per cent when the ground soybeans were fed and 2.55 per cent when soybean meal was used.

In this experiment, twenty-five feeding periods allowed seventeen comparisons to be made of the high- and low-fat rations. The high-fat ration favored milk production in five; fat percentage in fourteen, the average increase being 12.8 per cent; pounds of butterfat in fifteen, the average increase being 11.0 per cent; and pounds of fat-corrected milk in twelve, the average increase being 7 per cent.

The feeding of ground soybeans or soybean meal with alfalfa hay allowed milk and butterfat production to be maintained above or at least equal to what is expected of cows on good rations throughout the lactation.

P14. Studies on Ketosis in Cattle. J. C. SHAW AND L. D. MATTERSON, *Departments of Dairy Industry and Poultry Husbandry, Storrs Agricultural Experiment Station, Storrs, Conn.*

Nine cows with severe ketosis as shown by ketonemia, hypoglycemia and lack of appetite had an average blood-plasma carotene level of 321.8 micro-

grams per 100 ml. of plasma (range 131 to 768). Vitamin A was determined on seven of these animals and was found to average 24 micrograms per 100 ml. of plasma (range 14.4 to 33.6). The oral administration of from one to four million units of vitamin A per day for as long as three weeks was completely ineffective in improving the appetite or alleviating the hypoglycemia and ketonemia. Turning the cows out on pasture usually resulted in rapid recovery, in some cases in as little as two to three days.

P15. Symptoms of Scurvy Observed in a Herd of Cattle. C. W. DUNCAN, C. F. HUFFMAN, R. MITCHELL, JR., AND J. T. REID, *Michigan State College, East Lansing, Mich.*

Preliminary field observations made during the past winter and spring indicate that cattle may develop symptoms of scurvy under some conditions of livestock management. More than 35 cows and calves on one farm have died as a result of the disease.

The symptoms of the disease in the surviving animals were characterized by loss of weight and fatigue. Mouth examinations indicated that the interdental papilla, the marginal or the alveolar gingiva may be involved to a greater or lesser degree. The marginal gums in some of the animals were bluish to reddish in color, frequently swollen but in some cases receding from the teeth. Eroded areas were most frequently found on the upper dental pad, to a lesser extent on both the upper and lower pads and to a minor degree on the lower pad. There was no excessive salivation but less than normal seemed to be the rule. Lesions on the nose and lips were commonly found. The skin of the animals manifest a rough, dry scaly condition and some small reddened areas due to subcutaneous hemorrhage were observed.

The blood picture of these animals was characterized by low plasma ascorbic acid values, low hemoglobin values and low magnesium values. The addition of chlorobutanol to the regular ration caused a marked increase in the plasma ascorbic acid values, gradual healing of the eroded areas on the dental pads and a marked improvement in the skin condition.

P16. The Effect of the Level of Negative Pressure on the Rate of Milking. VEARL R. SMITH AND W. E. PETERSEN, *University of Minnesota, St. Paul, Minn.*

Rates of milk extraction by varying negative pressure were determined on eight cows. The rates were ascertained by suspending the milking machine pail from a scale and taking readings every ten seconds. Letdown was stimulated by a 15-second wash and massage two minutes before the teat cups were put on. Comparisons were made of rates of flow at 10, 12, 14, and 16 inches of mercury negative pressure on the line. The rate of pulsa-

tions was 50 per minute for all observations. Scale readings were made on two successive milkings for each negative pressure level and each level was repeated until there were ten milkings for the four levels.

The rate of flow at each negative pressure level varied markedly with individual cows. At ten inches of negative pressure the average rate of milk flow per ten seconds ranged from 0.43 to 0.58 pounds, at twelve inches from 0.50 to 0.68 pounds, at fourteen inches from 0.56 to 0.75 pounds, at sixteen inches from 0.66 to 0.84 pounds for the eight cows included in the study. The results show increased rates of flow with increases in negative pressure within the limits studied. There is not a straight line increase in rate of extraction with each increase in negative pressure for all cows. This phenomenon is based on two functions of negative pressure; first, increased opening of the meatus which varies with different cows; second, the increased rates of flow with increases in negative pressure.

These data when treated statistically show that the differences in rates between the different levels of negative pressure are highly significant.

P17. Studies of Mammary Gland Carbohydrate Metabolism in Vitro.

C. B. KNODT AND W. E. PETERSEN, *University of Minnesota, St. Paul, Minn.*

A series of experiments have been conducted in the study of the carbohydrate metabolism of the mammary glands involving incubation of tissue slices and the perfusion of excised mammary glands. It has been possible to increase the concentration of tissue glycogen in excised mammary glands by perfusion with high concentrations of blood glucose. It appears that glycogen can be converted in part to lactose during incubation of the previously perfused tissue. In perfusions where the concentration of blood glucose was greatly increased up to 5,611 mg. per cent there was not a significant change in the lactose concentration of the milk secreted during 6 hours of perfusion.

Lactose was formed during incubation of tissue slices with glucose, glucose and lactic acid, maltose, and glycogen. Lactic acid was formed by incubating tissue alone as well as from added glucose, maltose, glycogen, pyruvic acid, and citric acid. Citric acid was formed from glucose, lactic acid, pyruvic acid, maltose, and glycogen. Incubating mammary gland tissue slices utilize significant amounts of pyruvic acid.

Introduction of insulin greatly decreased lactose formation by the perfused mammary glands even though a hyperglycemia was maintained during the perfusions.

β-hydroxybutyric acid is utilized by mammary gland tissue slices. The rate of utilization bears a definite relation to the concentration present. Citric acid is not formed in an appreciable amount from β-hydroxybutyric acid during incubation.

P18. Pre-Partum Milking. E. A. KEYES, J. J. REID, S. I. BECHDEL, A. A. BORLAND, A. L. BEAM, AND P. S. WILLIAMS, *Pennsylvania Agricultural Experiment Station, State College, Pa.*

Pre-partum milking, or pre-milking as it is more commonly called, involves the milking of cows and heifers before freshening.

The work at The Pennsylvania State College has been done with special note being taken as to the effect on the cow and the bacteriological picture of the milk. Fifty-five cows have been on experiment so far. Twenty-five have been pre-partum milked 2 to 16 days and the remaining 30 have been used as checks. Quarter samples are taken on all pre-partum milked cows each milking before freshening and at least 4 days after freshening. Quarter samples are taken on all check cows at least 4 days after freshening. Some trends and results are indicated by the following figures. Thirty-one and two-tenths pounds milk per day is the highest on any pre-partum-milked cow before freshening to date.

	Pre-milked cows	*Not pre-milked*
Range, lbs. milk/milking before freshening	0.3 to 20.0	
" " " " after " (4 days)	1.0 to 37.5	2.0 to 35.5
Range, % fat in milk before freshening	0.2 to 11.0	
" % " " " after " (4 days)	1.9 to 9.4	0.9 to 10.5
Range, % total solids in milk before freshening	9.46 to 39.05	
" % " " " " after " (4 days)	10.47 to 25.19	9.92 to 34.75

The per cent total solids show a great deal of variation until about the seventh day before freshening when they become more uniform and gradually approach normal at time of freshening. Three days after freshening, the pre-partum-milked cows and the non-pre-milked cows average the same in per cent total solids.

The per cent butterfat stays between 4 and 5 per cent from the eleventh day before calving. As calving approaches, the per cent fat increases to about 5 per cent and stays around 5 per cent for at least 4 days after freshening. The non-pre-partum-milked cows average about 4.5 per cent at day of freshening and stay just under 5 per cent for at least 4 days after freshening.

The average total pounds of milk for the pre-partum-milked cows starts at around a pound a day and increases at the rate of 1 to 2 pounds a day until the third day before calving, when it increases at the rate of 5 to 6 pounds a day. A total of 25 pounds was reached the day of calving. This increases to 42 pounds the fourth day after calving. The non-pre-partum-milked cows start at 21 pounds the day of freshening and increase to 37 pounds the fourth day after freshening.

The carotene in the blood was determined every two days beginning with the sixth day before freshening and continuing to the fourth day after freshening. The blood contained 0.31 mg./100 cc. the sixth day before freshening

and suddenly dropped to 0.1 mg./100 cc. the day before freshening. After freshening there was a rise to 0.25 mg./100 cc. when it again dropped to a low of 0.03 mg./100 cc. The milk carotene gave the opposite picture. Starting at 0.03 mg./100 cc. and rising to 0.24 mg./100 cc the day before freshening. The day of freshening it increased to 0.4 mg./100 cc. then decreased, reaching 0.1 mg./100 cc. the fourth day after freshening.

The bacteriological picture is very interesting. Streptococcus of some form has been isolated from every cow whether she has been pre-partum milked or not. Alpha and beta streptococcus have appeared most frequently, with a few gamma. Excessive numbers of leucocytes have been found in all cows. The concentration of streptococci and leucocytes has been highest in the first milkings. The streptococci gradually disappear until 4 days after freshening when they cannot be detected by the regular bacteriological tests in most of the animals. During this period the number of leucocytes dropped to normal. By special tests with the use of a centrifuge the streptococcus can be detected in all cows at any time, which indicates they are normal flora of the cow's udder. When a cow has indurations in the udder or has been injured or ill, we have found a greater concentration of streptococci in the udder than with cows that appear perfectly normal in all respects.

Four calves from dams which had been pre-partum milked became ill. They had scours and showed signs of general inactivity. Five cc. of "Carotone" (a carotene preparation) administered daily has brought them back to normal in 7 days.

This experiment will be concluded next December. A more detailed report and conclusions will be drawn at that time.

P19. The Use of Simplified Diets in the Study of the Fat Metabolism of the Mammary Gland. O. W. KAUFMANN AND J. C. SHAW, *Department of Dairy Husbandry, Storrs Agricultural Experiment Station, Storrs, Conn.*

The effect of certain simplified diets upon the iodine number and Reichert-Meissl value of milk fat was studied in an attempt to obtain additional evidence as to the precursors of the lower fatty acids of milk fat. Diets consisting solely of skim milk, and corn starch and glucose resulted in an increased Reichert-Meissl value and a decreased iodine number within 48 hours. To determine whether the synthesis of the lower fatty acids from carbohydrate was direct or indirect, sufficient insulin was injected into fasting cows to maintain a hypoglycemia for approximately 30 hours. The rate of decline of the Reichert-Meissl value did not differ significantly from that observed on fasting alone. It is concluded that the decrease of the lower fatty acids on fasting is not due to a decrease in the blood-glucose level.

P20. Effect of Feeding Cod-Liver Oil by Two Different Methods on Butterfat Test.* L. A. MOORE, G. T. HOFFMAN, AND M. H. BERRY, *Maryland Agricultural Experiment Station, College Park, Md.*

It has been known for some time that the feeding of cod-liver oil to cows causes a depression in butterfat test. This reduction in test is thought to be due to the unsaturated fatty acids of the C_{20} and C_{22} series. It has also been noted that other highly unsaturated oils such as soybean oil and corn oil may cause some depression in test although the results are at variance. When corn oil or soybean oil are fed as corn grain or soybeans, there is no depression and sometimes an increase in test.

These differences suggested the possibility that the feeding of an oil, as such, so that a large amount of oil would be absorbed within a short period of time, was different than where the oil was fed in its original state in the seed so that only small portions of oil would be absorbed over a longer period of time. This difference might be due to the amount of saturation of the unsaturated fats by the animal during digestion and absorption which would have some effect on butterfat test.

Consequently, cod-liver oil was fed to two groups of cows by two different methods. One group was fed 5 to 7 oz. of cod-liver oil in one dose each day for 3 to 5 days. The other group was fed the same amount of oil but divided into 12 feedings for each day.

The results showed that when the oil was fed in one feeding, a marked depression of test occurred as has previously been reported. However, when the same amount of oil was distributed into 12 separate feedings over the 24-hour period, generally no such marked depression of test occurred. The iodine number was markedly elevated when the oil was fed as one feeding. When it was fed in 12 separate feedings, the iodine number was elevated but not as markedly as in the previous case.

These results with cod-liver oil, therefore, indicate that during the digestion and absorption of unsaturated fats there is some saturation taking place. The amount of saturation which takes place depends on the quantity and rapidity with which the oil is absorbed which in turn affects the butterfat test. If this same principle applies to other oils, it might explain the variation of results obtained on butterfat test by other investigators.

P21. Further Observations on the Initiation and Maintenance of Lactation in Dairy Cattle.* RALPH P. REECE, *New Jersey Agricultural Experiment Station, New Brunswick, N. J.*

Additional attempts have been made to induce and maintain lactation in dairy cattle by the administration of hormones.

* Scientific Paper No. A86$_2$, Contribution No. 1944 of the Maryland Agricultural Experiment Station (Department of Dairy Husbandry).

* Journal Series paper of the New Jersey Agricultural Experiment Station, Rutgers University, Department of Dairy Husbandry.

A 33-month-old barren Jersey heifer, 381X, received a total of 273 mg. of diethylstilbestrol dipropionate over a 14-week period. She produced 8,046 lb. of milk and 383 lb. of butterfat in 305 days. At the beginning of the 11th month of lactation 381X was producing 16 lb. of milk per day. At this time she received four weekly injections of 2 mg. diethylstilbestrol dipropionate plus 5 mg. testosterone propionate. Milk production eventually declined to 11 lb. per day and then increased to 19 lb. per day. In the following six months 381X produced 2,716 lb. of milk.

A 3-year-old Jersey heifer, 384X, received a total of 273 mg. of diethylstilbestrol dipropionate in 14 weeks. Milking was begun 14 days after the last injection and continued for five months. The level of milk production gradually increased, reached a peak daily production of 16.5 lb., and then declined to 12 lb. per day in the fifth month of lactation.

An Ayrshire cow, 472, that had calved five times was open and dry (Apr. 5). She was injected with 5 mg. of diethylstilbestrol dipropionate subcutaneously twice weekly for six weeks. Ten mg. and then 20 mg. of diethylstilbestrol were injected subcutaneously twice weekly for one week. At no time did the udder fill with secretion. Fifteen mg. of diethylstilbestrol were injected subcutaneously on July 9, 10, 11, 15, 19, 23, 26, 30, and Aug. 3 and 7. Milking was started July 20 and the animal reached a peak daily production of 17.8 lb. on Aug. 25.

A 26-month-old Jersey heifer was open and she was injected with 5 mg. of diethylstilbestrol dipropionate in conjunction with 5 mg. of tetosterone propionate twice weekly for eight weeks. The heifer's udder "made-up" at the beginning of the fifth week of the injection period and as a result daily milking was begun. Following 10 days of once daily milking the heifer was put on a twice-daily milking schedule. She attained a peak daily production of 14.8 lb. in the second month of lactation.

A 4-year-old Jersey heifer that had been through one normal lactation was dry and open (July 21). She received 5 mg. of diethylstilbestrol dipropionate subcutaneously twice weekly for eight weeks. Ten mg. of diethylstilbestrol were injected subcutaneously on Sept. 15, 16, 17, 22, 25, 28, and Oct. 1, 4, 6, and 8. Even though daily milking was carried out this animal never came into milk production.

P22. The Response of Louisiana Milk Cows to Iodinated-Casein Feeding.

D. M. SEATH, CECIL BRANTON, AND A. H. GROTH, *Louisiana Agricultural Experiment Station, Baton Rouge, La.*

Two trials have been completed on the feeding of iodinated casein (synthetic thyroprotein) to lactating Louisiana dairy cows. In the first trial two groups of 3 cows each were used under the single reversal design. Group I received iodinated casein for a period of 8 weeks and group II for 7 weeks. A 1-week preliminary, and a 3-week transition period between tests, were

used. Cows were fed 15 grams of the iodinated casein daily. In the second trial two groups of 6 cows each were used, one group being fed iodinated casein for an 11-week period.

In the first trial greater yields of milk with a higher percentage of butterfat were secured while the cows were being fed iodinated casein. These increases were accompanied by losses in body weight with certain individual cows showing heavy losses, while others were less affected. The iodinated casein also caused a substantial increase in pulse rate and a slight increase in body temperature. Cows used in this trial had been fresh an average of less than three months prior to the first experimental period.

The second (continuous feeding) trial used cows that had been fresh an average of 5½ months. For the first 6 weeks responses in milk production due to the iodinated-casein feeding were similar to those in the first trial, following which little differences were shown between the test and control groups. Again, there was a great stimulation to pulse rate and a slight increase in body temperature. Body-weight losses were again noted. An attempt was made to prevent excessive losses of weight by periodically varying the amount of iodinated casein fed from the original rate of 15 grams per 1,000 pounds live weight, but only moderate success was achieved.

In each experiment atmospheric temperatures (as measured by dry and wet bulbs) had an apparent marked influence on the body temperatures of both test and control cows. This influence was much more marked than was the influence of the iodinated casein. For example, in the first trial body temperatures of the group on iodinated casein averaged 105° F. at 5 P.M. on two days when atmospheric temperatures averaged 93.5° F. Likewise, cows not receiving iodinated casein in the second trial averaged 104.6° F. during a period of 2 days when atmospheric temperatures averaged 96.5° F. These high body temperatures raise the question relative to the advisability of feeding compounds such as iodinated casein to Louisiana milk cows during the warmer months of the year.

P23. Studies on the Utilization of Thyroprotein by Ruminants.* C. W. TURNER AND E. P. REINEKE, *Department of Dairy Husbandry, University of Missouri, Columbia, Mo.*

By the iodination of casein and other proteins rich in the amino acid tyrosine (under carefully controlled conditions), it has been found possible to produce an intramolecular synthesis of thyroxine, the hormone of the thyroid gland. This synthetic thyroprotein has been shown to increase the milk yield and fat percentage when fed to dairy cattle at the rate of 1.5 to 2.0 gm. per 100 lb. body weight. In comparison with the oral requirements of non-ruminant animals, it appeared that thyroprotein was being utilized inefficiently by cattle and other ruminant animals.

* Contribution from the Department of Dairy Husbandry, Missouri Agricultural Experiment Station, Journal Series No. 949.

As the organisms of the rumen are believed to break down food protein and synthesize organismal protein, it seemed possible that the losses of thyroprotein might be due to the partial breakdown of this protein and its recombination in the organisms in an inactive form.

In order to study this problem, sheep were selected as assay animals, and the loss in average body weight following the administration of the thyroprotein for a period of 2 weeks was used as an indication of response.

The results to date indicate that about 5 per cent as much thyroprotein is required when administered subcutaneously as when given orally by capsule. When thyroprotein is suspended in water and administered as a drench, twice the oral dose given by capsule is required. A series of substances such as stearic acid, paraffin, beeswax, rosin, clarite and vinylite have been applied to the particle in order to "protect" the thyroprotein in the rumen. Every coating tried so far has reduced the physiological potency rather than increased it.

In order to determine whether the losses occur in the rumen, a permanent cannula has been inserted into the abomasum or true stomach of a group of sheep. By administering the thyroprotein into the abomasum the entire rumen system can be by-passed. However, no difference was noted in the effectiveness of thyroprotein given by mouth or directly into the true stomach. From this it is concluded that the apparently low rate of absorption of thyroprotein in the digestive tract is not due to inactivation in the rumen.

Thyroprotein has been hydrolyzed with acid to determine whether better utilization would be obtained with a predigested product. Preliminary trials show that the hydrolysate is about twice as effective as the original thyroprotein when given either by mouth or directly into the abomasum. Thus the poor utilization of thyroprotein by ruminants may be explained in part by its low digestibility in the ruminant alimentary system.

P24. Studies of Thyroid Physiology by Use of Thiourea and Its Derivatives* E. P. Reineke, A. B. Schultze, and C. W. Turner, *University of Missouri, Columbia, Mo.*

It has been discovered recently that formation of thyroxine by the thyroid gland can be inhibited by the administration of thiourea, thiouracil and other thiourea derivatives. This results in a compensatory hypertrophy and hyperplasia of the thyroid gland due to increased output of thyrotropic hormone by the anterior pituitary in response to the induced thyroid deficiency. By the administration of thyroxine, thyroid gland substance, or artificial thyroprotein, the pituitary thyrotropic hormone can be held in check, and the size of the thyroid of thiourea- or thiouracil-treated animals is reduced

* Contribution from the Department of Dairy Husbandry, Missouri Agricultural Experiment Station, Journal Series No. 951.

in proportion to the dosage of thyroidal substance. It is thus possible to study, without surgical intervention, the effect of either thyroid deficiency or thyroid excess on physiological processes such as growth, lactation and reproduction. Also, the actual thyroid hormone output can be measured by determining the amount of thyroxine required to return the thyroid glands of thiouracil-treated animals to the normal weight. Thus the effect of such factors as age, breed, species, sex, diet and environment on thyroid hormone output can be studied.

Data are presented to show the effect of thiouracil alone and thiouracil plus graded amounts of thyroxine on the carbon dioxide output and thyroid gland weights of male albino rats. In rats receiving 0.1 per cent thiouracil in their drinking water the carbon dioxide output had declined 22 per cent and the thyroid gland weight per 100 gms. body weight had increased 117 per cent at the end of two weeks. When d,l-thyroxine was injected the carbon dioxide output increased and the thyroid weight decreased in proportion to dosage, both reaching normal levels within the range of 3.5 to 4.8 micrograms of d,l-thyroxine daily per rat.

Preliminary experiments were conducted on lambs and kids to determine the amount of thiourea required to suppress their growth and thyroid secretion. Varying degrees of growth suppression and cretinism were produced in lambs by the injection of 360 to 540 mg. of thiourea daily. The same dosage was effective when given orally. Goat kids were given thiourea starting at approximately one month of age, continued on treatment for 30 days and then slaughtered for examination of their glands and general condition. Maximum thyroid gland enlargement was obtained on a thiourea dosage of 360 mg. daily. Inasmuch as many drugs are known to be utilized poorly in the ruminant digestive system, it is of particular interest that thiourea was fully as effective when given orally as by the subcutaneous route.

Since thiourea and its derivatives will block out thyroid activity, and it had been established previously that an active thyroid is essential for maximum milk production, it was expected that thiourea would cause a decrease of production in lactating animals. Given orally to seven lactating goats, 750 mg. of thiourea daily for two weeks caused a 25 per cent decline in milk yield. Milk production began to recover by the seventh day after the dosage was stopped and closely approached the initial yield by the end of the third week. The application of this new technique to measurement of normal thyroid hormone output in dairy cows is discussed.

P25. The Effect of Pitocin on Milk Lipase. PHILIP L. KELLY, *University of Arkansas, Fayetteville, Ark.*

The method of lipase analysis used in these studies has been described. In the work reported here, the hormone, pitocin, was added to series of

samples of dried milk to study its effect on the milk lipase in comparison with similar samples to which no hormone was added.

With tributyrin as the substrate eleven series were carried out of which three were from normal milk, seven were from milk which developed rancidity and one was of unknown quality. In all but two of these series the hormone definitely increased the tributyrinase activity sometimes by almost 100 per cent. The two exceptions were both produced by the same cow and would have produced intense rancidity. In both, the addition of pitocin decreased lipase activity.

With triacetin as the substrate, in two series of normal milk the addition of pitocin increased lipolytic hydrolysis. This was also true for one series of normal milk samples with tripalmitin as the substrate.

The three series with ethyl-oleate including 119 individual analyses showed different results. In one series in which an unknown quality of milk was used, lipase activity was decreased to 10 per cent of its former activity. In the two series with normal milk, one showed no differences and in the other the lipase activity was increased.

When butter oil was the substrate the results again varied with four series showing increases, three showing decreases and one showing no definite difference. The effect of the hormone did not appear to be related to the type of milk used. In one of the series showing a decrease, samples of the same batch of dried milk showed a definite increase with tributyrin as the substrate. The remaining two series which showed decreases were from the same milk as those series which showed decreases in tributyrinase activity.

In four series either whole or dried milk samples were used with butter oil as the substrate. Distillation analyses were compared with the total fat analysis to learn whether the hormone had a selective effect on the short chain triglycerides. This was found to be true with the volatile fatty acids accounting for a large proportion of the changes produced. In one series with dried milk the total hydrolysis of the butter oil was not changed, but there was an increase in the volatile fatty acids indicating the hormone had increased the hydrolysis of some of the triglycerides and apparently inhibited the hydrolysis of others.

P26. Factors Affecting the Chylomicron Count. DWIGHT ESPE AND C. Y. CANNON, *Iowa State College, Ames, Ia.*

The number of chylomicrons in the blood of calves on grain and hay follow an entirely different cycle from that exhibited by young calves fed principally milk. The chylomicron count is much higher when calves are fed whole milk than when skim milk plus an equivalent amount of fat is given.

The number of chylomicrons can be reduced by feeding a watery extract of pancreas high in lipase.

P27. Morphology of the Teat in Relation to Milking and Trauma. W. E. PETERSEN, C. B. KNODT, AND W. L. BOYD, *Divisions of Dairy Husbandry and Veterinary Medicine, University of Minnesota, St. Paul, Minn.*

Four hundred teats including the gland sinus were obtained from dairy cattle, were dissected for gross structures, and 25 representative specimens were sectioned and studied microscopically. Great variations were noted in structures, either normal or due to pathology, that would affect milking by machine.

The annular fold demarking the gland and teat sinuses varied greatly in location and extent. In several cases there were two or three folds. Frequently this fold was sufficiently below the floor of the udder to be compressed by the teat cups so as to completely occlude the passage of milk from the gland into the teat. In many cases the fold was above the udder floor where compression by the teat cup is not possible.

Only about 10 per cent of the specimens studied were found to be free of pathology that could be detected grossly upon dissection. The pathologic findings varied from small inflammatory and fibrotic areas that could not be palpated to extensive fibrotic growths that practically occluded the teat sinus. In most cases this pathology was located in the upper part of the teat sinus and presumably had its origin from trauma produced by milking. In several cases pathology in the lower teat sinus could be attributed to previous severe trauma to that portion of the teat as evidenced by the finding of external scar tissue.

Histological examination revealed accessory secretory glands in the upper walls of the teat sinus in nearly all of the specimens and always in the gland sinus. These glands varied greatly in size, location in the teat and depth in the teat wall. Varying stages of pathology were observed in these glands. It is suggested that because of their structure and location they are frequently traumatized by milking which fact is a prominent predisposing factor in mastitis.

P28. Threshed Peanut Hay as a Roughage for Dairy Cows. A. H. KUHLMAN AND H. W. CAVE, *Oklahoma A. and M. College, Stillwater, Okla.*

The growing of peanuts as an essential war crop in many sections of the cotton belt has made available large amounts of cured vines commonly known as threshed peanut hay. If carefully conserved this by-product of the peanut crop can be used satisfactorily as a substitute for other legume roughages.

Two ninety-day experiments conducted according to the double reversal plan have been completed comparing the value of threshed peanut hay and alfalfa hay as roughages for dairy cows. In each trial a very good grade of

peanut hay, which was of good green color and very leafy, was compared with alfalfa hay of corresponding quality.

In the first trial in which threshed peanut hay produced in 1942 was used the daily hay allowance of each cow was slightly less than 1.6 pounds for each 100 pounds of body weight. Alfalfa hay fed at this level supplies an amount of total digestible nutrients equivalent to the requirements for body maintenance. The concentrate mixture fed in this trial consisted of 400 pounds ground yellow corn, 200 pounds ground oats, 200 pounds wheat bran, 100 pounds cottonseed meal (43 per cent protein), and 9 pounds of salt.

Nine cows when fed the alfalfa hay ration on the average produced 16.44 pounds of milk daily testing 4.25 per cent fat, equivalent to 17.06 pounds of 4 per cent fat-corrected milk. For each 100 pounds of 4 per cent milk produced they consumed 80.67 pounds of alfalfa hay and 62.03 pounds of concentrates. When fed the peanut hay ration these cows on the average produced 16.08 pounds of milk testing 4.36 per cent, equivalent to 16.96 pounds of 4 per cent milk. For the production of each 100 pounds of 4 per cent milk, 80.65 pounds of peanut hay and 61.03 pounds of concentrates were consumed.

In the second trial in which hay grown in 1943 was used, both kinds of hay were fed at the rate of 1.8 pounds of hay for each 100 pounds of body weight. The concentrate mixture used consisted of 400 pounds ground yellow corn, 200 pounds ground oats, 200 pounds wheat bran and 8 pounds of salt. Twelve cows when fed the alfalfa hay ration on the average produced 31.86 pounds of milk daily testing 3.64 per cent fat, equivalent to 30.13 pounds of 4 per cent milk. On the peanut hay ration these cows on the average produced 32.10 pounds of milk daily testing 3.68 per cent fat, equivalent to 30.55 pounds of 4 per cent milk.

To produce 100 pounds of 4 per cent milk the cows on the check ration consumed 61.42 pounds of alfalfa hay and 47.91 pounds of concentrates, as compared with 61.04 pounds of threshed peanut hay and 46.36 pounds of concentrates on the experimental ration.

The results of this study show that threshed peanut hay of good quality is equivalent in feeding value to alfalfa hay of similar quality.

P29. The Use of Urea in Commercial Dairy Feeds. W. H. HASTINGS, *Lindsey-Robinson & Co., Inc.*

Urease activity in ingredients and silage was tested. Some ammonia was liberated after two days when urea was mixed with soybean silage. Urease activity, probably of microbiological origin, was noted in all silage samples after seven days at ordinary temperatures.

Palatability of ingredients containing 50 to 60 lb. urea per ton was tried with Holsteins, Guernseys and Jerseys. No case of feed refusal, digestive disorder or "off-feed" could be traced to the presence of urea.

Feeding tests were made on a herd of registered Holsteins. Last year, the third consecutive year on official test, the herd average was 437 pounds of butterfat and 12,933 pounds of milk. Seven cows were chosen for the test group. These were average in age, previous production, and had freshened between September and November of last year. The rest of the herd received the control ration, which the whole herd had been getting for several years. Fifteen cows with an average history of production, freshened between September and November of last year, were chosen for record comparisons as the control group. Twice a day the cows were milked and the milk weighed. Official fat tests were used. All silage, hay and grain concentrates were weighed at each feeding.

Urea was added to the grain concentrate in such a proportion that in November, 17 per cent of the total protein from hay, silage, and concentrate was non-protein nitrogen. In December, 21 per cent of the total protein came from non-protein nitrogen. In January, 25 per cent and in February, 29 per cent of the total nitrogen was from urea. The February ration was continued throughout the rest of the test.

Milk production, butterfat, milk protein and body weight for cows on the test group did not vary significantly from the herd average from November, 1943, to June, 1944. If urea were not used as a source of protein, the cows on the test group were getting 0.5 lb. of protein per day less than they required for maintenance and milk production.

Another group of seven cows was selected for studying the effect on milk production and palatability of changing feeds suddenly. Abrupt changes of feeds with and without urea has no effect on milk production or palatability of feed.

P30. Corn Silage Made with the Addition of Urea and Its Feeding Value.

T. E. Woodward and J. B. Shepherd, *Bureau of Dairy Industry, Agricultural Research Administration, U. S. Department of Agriculture, Washington, D. C.*

Corn silage, made with the addition of 10 pounds of urea per ton of corn ensiled was fed along with low-protein concentrates and hay to a group of cows in a single reversal experiment for 100 days. Another group was fed similarly except that the urea was mixed with the concentrates instead of being ensiled with the corn. Both groups maintained their production of milk exceptionally well and the method of feeding urea had no significant effect. The cost of urea for these cows, which were producing 4 gallons of milk daily was a trifle over 1 cent per cow per day.

Although the seepage of juice from the silage amounted to 3 per cent there was no excessive loss of urea and there was no greater concentration of urea in the lower part of the silo. The addition of urea did not reduce the losses of dry matter, nitrogen, and carotene in the silo. Moderate addi-

tions of urea either to the silage or to the concentrates slightly impaired the palatability; heavier additions impaired it still more.

Ten of the cows were continued on experiment for 40 days to compare soybean meal with urea in a grain ration, 100 pounds of soybean meal being used to replace 14 pounds of urea and 100 pounds of low-protein concentrates. The decline in milk for the 40 days was 3.2 per cent as against 3.0 per cent for the preceding 40 days when urea was fed.

Small silos were filled with corn and heavier additions of urea. A Holstein cow ate in 61 days an average of 104 pounds of silage a day containing 1.17 pounds of urea. A Jersey cow ate in 60 days an average of 58 pounds containing 0.58 pound of urea. Post-mortem examination revealed no evidence of harm to either cow.

P31. Urea in Sorghum Silage.* GEO. K. DAVIS, R. B. BECKER, P. T. DIX ARNOLD, C. L. COMAR, AND SIDNEY P. MARSHALL, *Florida Agricultural Experiment Station, Gainesville, Fla.*

Sweet sorghum from an experimental planting was ensiled in 4 pilot silos, each holding about a ton of silage. Urea, in water solution, was mixed with the sorghum at the rates of 0, 10, 30 and 50 pounds of urea per ton in the different silos. Temperature changes in two of the silos, those containing 0 and 30 pounds of urea, were followed by means of thermocouples. The temperature increases were not large and those in the urea silage were slightly higher than those of the control. Some temperature differences were noted in the silos after opening. Temperature change did not appear to be related to urea content of the silage. Crude protein determinations demonstrated some migration of the nitrogen in the silos but the loss was slight. Urea determinations on silage as it entered the silos and after removal indicated that comparatively little of the urea was changed. Free ammonia was noticed in the silage containing the highest level of urea but in none of the other silages. Determination of pH in the silages gave values between 3.5 for the control and 7.6 for the 50-pound level of urea.

Palatability observations were made on the sorghum silages with dairy cows. The cattle ate the silages containing no urea and 10 pounds of urea per ton about equally well followed by that containing 30 pounds per ton. The 50-pound-per-ton level of urea caused this silage to be refused entirely until much of the free ammonia had disappeared from it.

P32. Urea-Treated Corn Silage vs. Untreated Corn Silage as a Feed for Lactating Dairy Cows. G. H. WISE, J. H. MITCHELL, J. P. LAMASTER, AND D. B. RODERICK, *Clemson Agricultural College, Clemson College, S. C.*

This is a report of a preliminary study designed to determine the feeding value of corn silage treated with urea in aqueous solution, two pounds of

* Published with the approval of the Director of the Florida Agricultural Experiment Station.

crystals (46 per cent nitrogen) per gallon of solution. This was added at the cutter at the rate of five gallons per ton of fresh ensilage material. Tap water was added to the control silage in the same volume as the urea solution was to the experimental silage.

The urea corn silage was of fair quality, possessing a slightly carmelized odor and a brownish color. There was no free ammonia, as detected by the sense of smell, except in the spoiled surface layer at the top of the silo.

Temperatures at the center of the silos, from 24 to 28 inches below the surface of the silages, were the same for the treated and the untreated. The sub-surface temperatures were different but variable and inconsistent. The significance of these variations has not been established.

As indicated by conventional feed analysis the only notable difference in the dry matter content of the fermented silages was in the "crude protein," which was 10.79 per cent for the treated and 7.48 per cent for the untreated. Average carotene values per gram of dry matter were 11.50 micrograms and 36.58 micrograms for the treated and untreated, respectively. The corresponding pH values were 4.3 and 3.6.

The palatability of the two silages and their comparative effects on carotene values of the milk, on milk production and on the weights of the cows were investigated by means of a double reversal feeding trial, which was conducted over three 42-day periods using two groups of 11 cows each. The respective silages, which were the only roughages in the rations, were fed slightly in excess of the amounts the individual cows consumed. The concentrates, fed at the same level in both groups, were adjusted according to the milk production of all the cows in the test.

The palatability of the treated silage was somewhat low; the average daily consumption per cow was 52.5 pounds (15.5 pounds of dry matter); whereas that for the untreated was 60.0 pounds (16.9 pounds of dry matter).

The effects of differences in the carotene values of the silages were reflected in the carotene concentrations of the milk; the average per liter of four per cent fat-standardized milk was 153.5 micrograms for the treated and 258.6 micrograms for the untreated.

The productive values of the two silages were similar. The average daily production of four per cent fat-corrected milk per cow was 24.7 pounds for the treated and 24.5 for the untreated. The average total gains in weight per cow for the trial were 43 pounds for the treated and 56 pounds for the untreated.

These data indicate that treating corn silage with urea does not improve the over-all feeding value of the resulting silage.

P33. The Minimum Protein Requirements of Young Holstein Calves.

L. T. HARRIS AND J. K. LOOSLI, *Laboratory of Animal Nutrition, Cornell University, Ithaca, N. Y.*

Calves were reared to eight weeks of age according to the whole milk–dry

starter system used by Savage and Associates. From the eighth to the sixteenth week they were fed diets containing 8.3, 11.7, 15.2, and 18.8 per cent crude protein (dry basis). Nitrogen balances were run on the males at approximately the tenth and fifteenth week. The diets included only plant proteins and were balanced in energy, fat, calcium and phosphorus content.

Heifers fed the 18.8 per cent protein diet ad libitum were slightly larger than normal (Ragsdale). Diets containing 15.2 and 11.7 per cent of protein permitted a growth rate slightly below normal. Bull calves on a somewhat limited intake of food were all below normal in rate of gain. There was no apparent difference in the gains of the males receiving diets containing 18.8 and 15.2 per cent protein. The diet with only 8.3 per cent protein gave very poor growth.

About the same amounts of nitrogen were stored by calves fed the diets containing 15.2 and 18.8 per cent protein but the other two diets gave appreciably less storage of nitrogen. Endogenous and metabolic nitrogen determined on some of the calves when they averaged 97.2 kgm. in weight and 137 days of age, were 0.041 gm. per kgm. (1.999 gm. per M^2) and 0.372 gm. per 100 gm. dry matter consumed, respectively.

P34. Studies on Carotene Conversion in the Young Calf. NORMAN S. LUNDQUIST AND PAUL H. PHILLIPS, *University of Wisconsin, Madison, Wis.*

Calves fed beta carotene as the only source of vitamin A from birth failed to survive in 75 per cent of the cases, whereas those fed vitamin A failed to survive in only 40 per cent of the cases. When vitamin A *per se* was fed, blood plasma levels of 9 to 11 micrograms per 100 ml. were reached in 8 to 10 days, whereas with carotene these levels were not reached until the 20th day. Blood plasma levels were maintained in the calves receiving either 18 or 90 micrograms per kg. body weight of vitamin A. Calves getting vitamin A *per se* did not reach plasma carotene levels above 4 micrograms per 100 ml. during the 4 weeks of the experiment. Calves fed the carotene showed a concentration of 11 micrograms per 100 ml. during the first week, after which a rather wide variation occurred with a maximum of 17 micrograms per 100 ml. blood plasma.

There was no observable difference in blood-plasma ascorbic acid between the groups. The blood-plasma vitamin-C curve was nearly identical to that reported earlier for calves on a skimmilk diet and getting vitamin C per os. Administration of 2 grams daily of succinyl sulfathiazole had a slight effect in maintaining higher blood-plasma ascorbic acid during the first week. Blood-plasma ascorbic acid levels of calves at death was 0.49 mg. per cent, indicating death was not due to an active infection. However, all calves which died had 5 micrograms or less of vitamin A per 100 ml. blood plasma at death.

P36. The Effect of Sulfa Drugs and Immunity Development Upon Blood-Plasma Vitamins A and C in the Young Bovine. NORMAN S. LUNDQUIST AND PAUL H. PHILLIPS, *University of Wisconsin, Madison, Wis.*

During the first two weeks of the life of the newborn calf, succinyl sulfathiazole, when fed at the low level of 2 grams per day, resulted in higher blood-plasma ascorbic acid levels than in untreated calves. This drug did not appear to have any effect on blood-plasma vitamin-A or carotene levels. Sulfapyridine or succinyl sulfathiazole had no effect in increasing blood-plasma ascorbic acid above normal in young Holstein heifers. Sulfathiazole, however, caused a very definite increase. This effect was somewhat similar to that caused by the feeding of chlorobutanol. When the latter two drugs were given consecutively, a marked reduction in blood-plasma ascorbic acid occurred. The addition of sulfathiazole or succinyl sulfathiazole to the diet did not interfere with the destruction of vitamin C in the rumen, since no increased effect was noted in blood plasma levels, even when this vitamin was also fed.

Blood-plasma ascorbic acid and vitamin-A levels were temporarily reduced by calfhood vaccination, irrespective of additions of these vitamins to the normal diet. A rise in rectal temperature followed closely the drop in blood-plasma ascorbic acid. The leucocyte count which increased on the day following inoculation returned to normal in five days. Differential count showed that the neutrophiles were increased, the lymphocytes decreased, and monocytes and eosinophiles not materially affected. The calves when vaccinated were normal with respect to vitamin nutrition and did not develop deficiency symptoms.

P37. The Use of Stored Colostrum to Replace Marketable Milk for Calf Feeding. N. N. ALLEN, *Vermont Agricultural Experiment Station, Burlington, Vt.*

Milk is one of the most expensive items in the feed cost of raising calves, even if the amount fed is kept at a minimum, and in aggregate this accounts for a large volume of milk. With present high prices and wartime demands, this takes on additional aspects of importance.

Colostrum is unmarketable and is usually produced in excess of the immediate needs of the calf. This surplus is often wasted or used to poor advantage. If it could be held until needed, it has possibilities in replacing salable milk for feeding calves beyond the age of normal colostrum feeding. It has repeatedly been shown that colostrum may be stored in frozen condition without seriously affecting its nutritional properties. Because of its bulk, the cost is relatively high if artificial refrigeration is used. In the northern parts of the country natural refrigeration may be used during the winter months. In the New England area a large portion of the cows are

bred to freshen during the months when winter temperatures permit freezing and frozen storage without mechanical refrigeration. On most farms in this area less than a third of the calves are raised and if the total colostrum production were utilized, it might replace most of the milk now used for calf feeding.

At the Vermont Experiment Station, some of the practical possibilities of using colostrum for this purpose are being studied.

Three plans have been followed and compared. Under one plan, the calves serving as a control group received the fresh colostrum or milk from their dams as produced during the first ten days. Under the second plan, the calves received colostrum stored in frozen condition, during the first ten days. After ten days, the calves of both groups received fresh mixed milk from the herd until 24 days of age when they were changed (with a three-day transition period) to skimmilk which was fed until they reached 63 days of age.

Under the third plan, the calves received stored colostrum, with no other milk until 63 days of age.

No serious digestive disturbances occurred in any of the calves. The calves of all three groups made very satisfactory gains. The control group lost weight between the second and fourth days, probably due to the change in composition of the mothers' milk at that time, while the colostrum-fed groups did not. As a result, the growth curve of the control group was slightly below that of the colostrum-fed groups after the second day, but the rate of gain was essentially the same. The calves receiving colostrum throughout the milk-feeding period were fatter and sleeker of coat, showing the characteristics of whole-milk-fed calves. Two slaughtered at 9 weeks of age showed good finish, and made veal of very good quality.

Some of the colostrum fed had been in storage for over a year. During the winter months colostrum was frozen and stored for periods of more than two months without artificial refrigeration. It was shown clearly that colostrum stored in frozen condition is entirely satisfactory as a substitute for marketable milk for feeding calves during any part of the milk-feeding period.

P38. Experiences with the Forage Harvester in Making Grass Silage.
C. F. MONROE, *Department of Dairy Industry, Ohio Agricultural Experiment Station, Wooster, Ohio.*

For the past two seasons a forage harvester* has been used to cut and chop green material in the field for grass silage. This machine can chop the material as it stands in the field or after it has been allowed to partially dry in the windrow or swath. The experimental work has been concerned chiefly with ensiling the crops without wilting. Since such material may

* In cooperation with the Allis-Chalmers Co., Milwaukee, Wis.

contain an excess of moisture, emphasis has been placed upon the use of dry matter increments, such as ground shelled corn, ground ear corn, and beet pulp. With these treatments acceptable grass silage has been made using the forage harvester. For measuring the quality of the silage, palatability trials have been conducted with dairy cows and heifers, beef cows, and also sheep. The forage harvester offers a means of reducing the labor and irksomeness of making grass silage.

P39. Development and Use of the Barn Haydrier. C. E. WYLIE, *Tennessee Agricultural Experiment Station, Knoxville, Tenn.*, AND JOHN A. SCHALLER, *Agricultural Engineer, Tennessee Valley Authority.*

For several years agricultural workers have realized that a limiting factor in the production of high quality hay in the southeast is the difficulty of curing it. With about 50 inches of rainfall a year, the southern states have some of the nation's best hay GROWING weather and some of the worst hay CURING weather.

Through several years of research, beginning in 1935, a method of barn curing of hay was developed jointly by the Tennessee Valley Authority and the Tennessee Agricultural Experiment Station, involving low first cost and low operating cost to complete the curing of hay in the barn after taking advantage of several hours of field curing. The University of Georgia conducted studies from 1937 to 1940 on the adaptation of this method to the climatic and operating conditions in Georgia. Virginia Polytechnic Institute began similar studies in 1939, which also covered the use of artificial heat.

Briefly, the hay drier consists of specially constructed air ducts on the haymow floor. Partially dried hay (40 to 50 per cent moisture content) from the field is stored as usual over the air ducts. A blower or fan, either the centrifugal or propeller type driven by an electric motor or gasoline engine, connected to the air ducts underlying the hay, forces air up through the hay and removes the moisture.

Past experience has definitely shown that with a barn haydrier a farmer can do two things: (1) eliminate some of the weather risk in haymaking and (2) make a superior quality of hay with a total cost of $1.40 to $1.65 per ton.

Quality studies show barn-dried hay to be consistently better by at least one grade than similar field-dried hay. The price differential on the southern markets between U. S. No. 1 and U. S. No. 2 range from $2.40 to $3.00 in peacetime and is even greater during wartime. The gain then to the farmer would be $1.00 to $1.50 per ton of hay plus the gain in weight of hay.

Feeding trials with barn-dried hay have been conducted at the Tennessee Experiment Station with dairy cattle and other livestock. In general, more attention has been given to developing and improving the method of drying

the hay than to checking the feeding value of the hay. The improvements in the method of drying have been rapid from year to year and still are subject to further improvement.

During wartime when protein feeds are scarce and every ounce of feeding value in the hay should be saved, the importance of the barn haydrier is even greater. The War Production Board has allocated materials for 300 installations this season in the Southeastern states in addition to materials for other states.

P40. Congenital Muscular Contracture and Ankylosis in Jersey Cattle. A. A. SPIELMAN, O. J. HILL, AND E. C. MCCULLOCH, *State College of Washington, Pullman, Wash.*

The occurrence of a large number of calves with congenital deformities in several registered Jersey herds of similar breeding is being investigated. To date, records of 69 cases have been accumulated.

Although considerable variation occurs in the appearance of these anomalies, both lethal and sublethal, the gross manifestations appear to be varying degrees of muscular contracture and ankylosis. Deformities of the extremities, mainly the forelegs, are characteristic of all the cases. In addition, some of the abnormal calves have a wry neck, flexure of the spinal column and incompletely developed palate. The extent of these deformities in many cases caused severe dystocia, necessitating either dismemberment or Caesarian delivery.

A fairly close degree inbreeding of identical bloodlines has been practiced in all the herds where these abnormalities have been observed. Although the malformations observed in these cases are similar to the muscular contracture condition described by Löje, Williams and Hutt as being hereditary, final etiological judgment is withheld until further investigation because unfavorable prenatal nutrition and environment may also cause congenital deformities.

P41. The Optimum Emphasis on Dams' Records when Proving Dairy Sires. JAY L. LUSH, *Iowa State College, Ames, Ia.*

Nearly all proposals for evaluating the proof of dairy sires are special forms of the general equation $I = a + c(X\text{-}bY)$ in which I is the index or other measure of the bull's breeding value, X is the average production of his daughters, Y is the average production of the dams' of those daughters and a, b and c are constants which define the kind of index being used. This paper shows what value of b will make the correlation between I and the real breeding value of the sire as high as it can possibly be for any index of the general type described by the above equation. If the sire's breeding value is not correlated with Y, the optimum value of b is the regression of

X on Y which is between 0.5 and 0.6 in most dairy data as actually used for proving sires. If the sire's breeding value is slightly correlated with Y, as might result from assortive mating, the optimum value of b is a little smaller than this regression of Y on X. The widely used "intermediate" or "equal-parent" or "modified Mount Hope" index uses 0.5 for b.

The values of a and c do not affect the *accuracy* of the index but may make it easier or harder to understand, more susceptible or less susceptible to misinterpretation, etc. Changing c will expand or contract the variability of the index. Changing a will affect only the general level or average of the indexes. The most satisfactory value for c is that which will make the indexes of sires about as variable as either (1) the records of cows or (2) the most probable breeding values of the sires. There are some arguments in favor of each of these alternatives.

P42. Comparison of the Incidence of Udder Infection in Two Cow Families. JAMES M. MURPHY, K. O. PFAU, O. L. LEPARD, AND J. W. BARTLETT, *New Jersey Agricultural Experiment Station, New Brunswick, N. J.*

The occurrence of udder infection was studied for a period of six years in two cow families living under the same conditions in a herd of 60 milking cows. The one family was composed of the dam (283), three daughters, and two granddaughters. The other family was composed of the dam (247), four daughters, and two granddaughters. Of the former family, seventeen lactation periods were studied: four *first*, four *second*, three *third*, three *fourth*, and three *fifth*. Of the latter family, eighteen lactation periods were studied: five *first*, four *second*, three *third*, three *fourth*, one *fifth*, one *sixth*, and one *seventh*.

In evaluating the incidence of infection, a system was devised whereby the infection present in each quarter could be stated in terms of the percentage of the lactation period during which it was present. By this method it was found that family 283 was infected with streptococci during 23.9 per cent of its milking time and by staphylococci during 39.3 per cent of its milking time. The total incidence of infection was 63.3 per cent. Family 247, on the other hand, was found to be infected with streptococci during 0.9 per cent, and with staphylococci during 10.9 per cent, of its milking time. The total incidence of infection was 11.8 per cent.

The mastitis history (considered entirely separately from infection which was determined bacteriologically) of the two families was judged by periodic leucocyte counts of strict foremilk, daily strip-cup examination of foremilk, and periodic physical examination of the udders. Family 283 showed a leucocyte content of 500,000 or more per cc. in 179 (42.1 per cent) of 425 samples of strict foremilk, showed the presence of flakes or more marked alteration of the secretion at 454 daily strip-cup examinations, and averaged

No. 3 by the Udall system of udder physical examination. Family 247 showed a leucocyte content of 500,000 or more per cc. in 55 (10.3 per cent) of 536 samples of strict foremilk, showed the presence of flakes or more marked alteration of the secretion at 192 daily strip-cup examinations, and averaged No. 2 by the Udall system of udder physical examination.

P43. The Effect of the Oral Administration of Chloretone to Bulls on the Fertility of the Semen Produced. IRVINE ELLIOTT, *Cornell University, Ithaca, N. Y.*

Six mature bulls, 3 Holstein and 3 Guernsey, all in active service through artificial insemination, were fed 5 g. daily doses of "Chloretone." The bulls were not "slow breeders" but had been producing semen low in spermatozoa concentration, percentage progressive motility, and fertility.

The "Chloretone" was fed for 8 days, discontinued for one week, and again fed for 21 days. The level of ascorbic acid was increased as much as 100 per cent in the blood plasma of the bulls following treatment. The ascorbic acid content of the semen was also increased, but no other effect on semen quality was noted.

P44. Storage of Bovine Spermatozoa in Diluents Containing Certain Amino Acids (Progress Report). C. E. KNOOP AND W. E. KRAUSS, *Ohio Agricultural Experiment Station, Wooster, Ohio.*

The accumulation of laboratory and breeding data has shown that the egg-yolk–gelatin buffer diluent for bovine spermatozoa is reliable for maintaining fecundity of average to excellent quality spermatozoa after 6 to 14 days in storage. Sperm cells stored in this diluent maintained an average of 20 per cent more living cells after 8 to 10 days than when no gelatin was used. An attempt is now in progress to explain this difference by first removing the gelatin and adding some of the major amino acids found in gelatin. Criteria used to date have been hydrogen ion content, motility rating, and breeding record.

The first two amino acids studied have been glycine and proline plus hydroxyproline because they represent 25.5 and 23.6 per cent, respectively, of gelatin protein. The hydrogen ion content of the buffered portion of the amino acid diluents was approximately 7.20 pH and of the completed diluent approximately 6.30 pH.

Results show that a high percentage of living sperm cells was maintained in storage for 2 weeks in a buffered portion of diluent containing 1.09 per cent of glycine or "l"-proline, 0.2 per cent sodium phosphate, and 0.08 per cent potassium phosphate mixed with an equal volume of fresh egg yolk. On the average, the amino acid diluents maintained 36 and 49 per cent more living cells after 12 days in storage than did the egg-yolk–gelatin and egg-

yolk diluents, respectively. The rate of motility also remained good in two-thirds of the diluted samples containing glycine or "l"-proline.

P45. Recent Observations on the Preservation of Bull Semen. HENRY A. LARDY AND PAUL H. PHILLIPS, *University of Wisconsin, Madison, Wis.*

Chemical studies on the phosphorus partition of bull spermatozoa indicates that adenosine triphosphate (or a chemically similar compound) is present in bull spermatozoa in appreciable quantities. The enzyme adenosine triphosphatase which breaks down adenosine triphosphate to adenylic acid and inorganic phosphorus is likewise present. A second enzyme has been separated from the adenosine triphosphatase by acetone treatment and has been shown to be specific for the hydrolysis of adenosine-5-phosphate yielding inorganic phosphorus. These results indicate a great similarity in the energy metabolism of striated muscle and spermatozoa, and attempts have been made to apply this knowledge to the storage of semen for artificial insemination.

When methods of arresting muscle contraction were applied to spermatozoa the results were variable. Attempts at ion displacement of the activators of adenosine triphosphate did not result in inactivation of the spermatozoa. The only procedure which was found to allow reversible inactivation of the spermatozoa was treatment with fluoride. Some specimens could be inactivated for periods up to 7 days and following centrifuging and dilution of the spermatozoa with fresh yolk-buffer vigorous motility was resumed.

The relation of the enzyme hyaluronidase to fertility of bull semen has also been investigated and will be discussed.

P46. Further Studies of the Effect of Dilution Rate on the Fertility of Bull Semen Used for Artificial Insemination. G. W. SALISBURY, IRVINE ELLIOTT, AND N. L. VANDEMARK, *Cornell University, Ithaca, N. Y.*

In a continuation of studies previously reported (JOUR. DAIRY SCI., **26**: 1057–1069, 1943) an investigation has been made into the effects of increased dilution of bull semen upon its fertility when used for routine artificial insemination. When insemination was made deep into the uterus with 1.0 cc. or less of diluted semen no difference in fertility was found between dilution rates of 1 part of semen to 8, to 12, to 16, to 24, or to 50 parts of the yolk-citrate diluter. No difference in quality was found for the semen used at the several dilution rates as indicated by spermatozoa count, initial motility, and methylene blue reduction time. No semen was used which contained less than 1,000,000 spermatozoa per $mm.^3$ or which exhibited less than 50 per cent

of actively motile spermatozoa. With the highest rate of dilution, 1:50, about 26 million spermatozoa were used per insemination. 3,296 inseminations were made during the investigation.

P47. Conception Rate in Dairy Cattle by Artificial Insemination at Various Intervals Before and After Ovulation. G. W. TRIMBERGER, *University of Nebraska, Lincoln, Nebr.*

A total of 132 females of the Ayrshire, Jersey, Guernsey, and Holstein breeds in the University of Nebraska dairy herd were checked at two-hour intervals during and following the heat period to determine the end of estrus and time of ovulation on the average within a time interval of one hour or less. Females were considered in heat if complacent when mounted and the time of ovulation was determined by palpation of the ovaries per rectum through the intestinal wall. The rupture of the follicle on the ovary indicated ovulation.

The females were bred at various time intervals before and after ovulation to determine the effect of this factor on breeding efficiency. Services before ovulation were grouped as follows: More than 24 hours before rupture of the follicle, from 19 to 24, 13 to 18, 7 to 12, and 6 hours or less before ovulation. Three groups of females were bred after ovulation with 20 in each one of the following groups: 2 hours or less after ovulation, 6 hours, and 12 hours after rupture of the follicle. All services were by artificial insemination with semen of high quality from bulls with a good breeding record. Semen samples used were stored from one to three days or more as is a common practice in cooperative artificial breeding associations. For these inseminations 0.25 cc. of semen diluted 1:3 with egg-phosphate buffer or a total of 1 cc. diluted semen was used and the semen was deposited in the uterine horn on the side where the ovary had developed the follicle.

Under practical conditions when the females were observed three times daily the duration of estrus had a range from 2½ to 28 hours and averaged 16.92 hours (86 cows averaged 17.77 hours and 46 heifers averaged 15.33 hours). Ovulation time after end of estrus had a range from 3 to 18 hours with an average of 10.49 hours (86 cows averaged 10.66 hours and 46 heifers averaged 10.16 hours).

Breeding efficiency, from one insemination, of the females in the various groups is tabulated below:

Time of breeding	*No. females*	*Conceptions*	
		No.	*%*
More than 24 hours before ovulation	15	8	53.33
From 19 to 24 hours before ovulation	15	11	73.33
From 13 to 18 hours before ovulation	14	12	85.71
From 7 to 12 hours before ovulation	14	11	78.57
Six hours or less before ovulation	14	8	57.14
Two hours or less after ovulation	20	6	30.00
Six hours after ovulation	20	8	40.00
Twelve hours after ovulation	20	6	30.00

Although there are no significant statistical differences among the groups bred before ovulation, there is a trend toward a higher rate of conception in females bred from 6 to 24 hours before ovulation, which coincides with a previous study in which the highest rate of conception was obtained in the middle and toward the end of the heat period. A total of 72 females were bred in the various groups before ovulation and 50, or 69.44 per cent, conceived. Only 20, or 33.33 per cent, of the 60 females bred 12 hours or less after ovulation conceived, and this indicates that the bovine ovum in many cases remains fertile only a relatively short time after ovulation.

To provide information useful for breeding cows in cooperative artificial breeding associations, the females were tabulated as to the time estrus was first observed. Eighty-one, or 61.36 per cent, of the females were in heat in the forenoon and 51, or 38.64 per cent, were first observed in heat in the afternoon. Females observed in heat in the forenoon averaged 15.57 hours for duration of estrus as compared to 19.07 hours for females first observed in heat during the afternoons. The latter represents about the normal time for the heat period, for the females in this group were detected soon after the start of estrus. The time heat was first observed was then compared with the time of ovulation on the following day. Breeding results can be predicted based on the assumption that females bred before ovulation have a good chance for conception and those bred after ovulation will have a poor conception rate. The practical question involved is what conception rate can be obtained in cows bred the day following estrus if these inseminations are either in the forenoon or in the afternoon. Results from 81 cows in heat in the forenoon indicated that 31, or 38.27 per cent, had ovulated before 8:00 A.M. the next day. Another 16, or 19.75 per cent, ovulated during the forenoon and 30, or 37.04 per cent, ovulated during the afternoon. Only 4, or 4.94 per cent, ovulated after 6:00 P.M. of the day following estrus.

Among the 51 females which were first observed in heat in the afternoon, none had ovulated before 8:00 A.M. the next morning and only 2, or 3.92 per cent, ovulated during the forenoon. Seventeen, or 33.34 per cent, ovulated in the afternoon before 6:00 P.M. and 32, or 62.74 per cent, ovulated after 6:00 P.M.

Since breeding efficiency is high for females inseminated before the follicle is ruptured and low for those bred after rupture of the follicle, the females in heat during the early forenoon should be bred on the same day. Females coming into estrus in the afternoon can be bred any time during the following day with good results, but there is some advantage to breeding such cows in the forenoon or early in the afternoon. If a farmer in a cooperative breeding association carefully observes his cows, he can report females in heat in the forenoon for service on the same day, and those which come in heat in the afternoon can be reported the next morning and bred during the forenoon or early afternoon with good results.

P48. The Methylene Blue Reduction Test and Its Relation to Other Measures of Quality in Bull Semen. G. W. SALISBURY, ERNEST MERCIER, AND N. L. VANDEMARK, *Cornell University, Ithaca, N. Y.*

In an experiment involving 116 separate ejaculates of bull semen the correlation between the methylene blue reduction test (JOUR. DAIRY SCI., **26**: 483–494. 1943) and several other characteristics concerned in measuring semen quality was determined. Correlations were calculated using individual ejaculates so that the results would be applicable for prediction with respect to any single semen sample. The semen ejaculates in the study represent collections from 39 individual bulls during 6 different months throughout the year. Marked differences were found in the degree of association between certain characteristics at the various seasons represented.

The measured characteristics which were not significantly correlated with the methylene blue test included the proportion of abnormal spermatozoa, the ascorbic acid, glucose, and lactic acid levels of fresh semen, and the glucose loss in diluted semen stored 10 days at 5° C. The test was significantly correlated with pH in a positive direction and with volume in a negative direction.

However, the methylene blue test held a highly significant negative correlation with livability, glucose loss, and lactic acid gain in diluted semen after an hour's incubation at 46.5° C. Similar highly significant negative correlations also were found with livability and lactic acid gain in diluted semen stored for 10 days at 5° C. The high degree of association between the methylene blue reduction time and the products involved in glycolysis, the original count and motility, as well as its close relationship with livability indicates that the test is actually a rapid method of measuring the potential ability of spermatozoa to continue glycolysis and live.

P49. The Effect of Pregnancy on the Body Weight of Dairy Cows. D. N. PUTNAM AND H. O. HENDERSON, *University of West Virginia, Morgantown, W. Va.*

Normal growth curves have been developed for all the breeds of dairy cattle. These are usually measured by the weight of the animals and by the height at withers. While pregnancy does not greatly affect the height of withers it does affect the weight of the animals. After the animal is bred the weight curve takes an upward turn, and this curve is no longer a measure of the growth, but includes also the weight of the fetus and accompanying material, including the fetal membrane and amniotic fluid.

To determine how much this curve was affected by pregnancy a study was made at the West Virginia Agricultural Experiment Station with 56 normal Ayrshire females that had calved at least three times. The same animals were used throughout the study. The average age for first calving

was 32 months; for second calving, 46 months; and for the third calving, 59 months.

The following results were observed: (1) The body weight shows a definite pattern for increase as the stage of pregnancy advanced. (2) The gain in weight over and above normal weights was not great before the fifth month of pregnancy. From 75 to 85 per cent of the gain came in the last four months of pregnancy. (3) The gain in weight from month to month was much more uniform with first calf heifers than with the older animals. This was probably because the heifers were still growing and not producing milk. (4) In every case, the animals gained less on the average during the eighth month of pregnancy than they did in the preceding and following months. (5) The animals in the last month of pregnancy were on the average 139 pounds heavier than open heifers of the same age. During the first pregnancy they were 115 pounds heavier; the second pregnancy, 147 pounds heavier; and the third pregnancy, 155 pounds heavier.

P50. Factors to Consider in Long-Distance Shipping of Semen.* H. A. Herman and Eric W. Swanson, *University of Missouri, Columbia, Mo.*

The shipping of dairy bull semen to distant points occupies an important place in fully utilizing sires of superior breeding for artificial insemination purposes. There are three very important factors affecting the success of long-distance semen shipping: (1) A sire capable of producing spermatozoa with an inherent capacity for long-time survival under storage conditions; (2) proper handling and packaging of the semen in a container which will maintain temperatures of 35 to 50° F. until delivery; and (3) proper evaluation and use of the semen upon arrival at its destination.

The capacity of semen to withstand storage is usually one of the limiting factors affecting the success of this program. At least 40 per cent of the sires studied at the Missouri Station have yielded semen unsatisfactory for shipment to distant points, though many such bulls would be satisfactory if the semen was utilized within 6 to 20 hours. In a study of 475 inseminations using stored semen it was found that as viability of the sperm increased the conception rate increased until 68 per cent of the inseminations with the most viable semen resulted in conception. A highly significant linear correlation (0.84) was found between viability of sperm in storage and their ability to produce fertilization. The motility rating of semen may give a good insight into its capacity to produce conception, and in 565 conceptions an index of correlation of 0.97 was obtained. The difference in conception rate between semen rated 3 motility (45 per cent or more progressively motile sperm) and higher grades of motility was slight. Semen

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containing less than 20 to 45 per cent progressively motile sperm was not very satisfactory for storage and shipping as only 43 per cent conceptions resulted from its use. The correlation between pH, abnormal sperm, and concentration of sperm is generally of low significance as compared to the importance of (1) ability to withstand storage and (2) the motility rating.

At the Missouri Station a small insulated ice cream shipper fitted with a metal can to contain crushed ice and a vacuum bottle has been found to be very satisfactory for long-distance shipping. Semen temperatures of 35 to 50° F. have been maintained in this container for 84 hours at atmospheric temperatures of 80° F. Less complex shipping containers are satisfactory for intra-state shipments.

Using the above technique, semen shipped from Missouri to New Jersey has resulted in 20 pregnancies from 42 inseminations (semen 60 to 70 hours old when used). Additional shipments from Missouri to Indiana, and from Oklahoma to Missouri have resulted in 25 pregnancies from 47 inseminations, giving an average of 1.98 inseminations per conception for all shipments.

MANUFACTURING SECTION

M1. Factors Which Influence the Apparent Survival of Heat-Treated Bacteria. F. E. NELSON, *Iowa State College, Ames, Ia.*

The quantitative effects of variations in medium and temperature of incubation employed in making plate counts on dairy products commonly are attributed to the establishment of conditions such that the numbers of species or strains of bacteria which are able to produce countable colonies is changed. While this explanation may be adequate under some circumstances, results previously reported, using pure cultures of heat-treated bacteria, have shown that numbers of colonies can be influenced markedly by the plating medium employed. The results of certain studies of quantitative and qualitative changes in composition of the plating medium, of certain methods of combining the ingredients, of pH of the medium and of time and temperature of incubation upon plate counts of heat-treated bacteria are reported in this paper. *Escherichia coli, Pseudomonas aeruginosa, Staphylococcus aureus, Bacillus subtilis, Streptococcus durans, Streptococcus liquefaciens* and *Streptococcus zymogenes* were used as test organisms. Milk or broth cultures of these organisms were diluted with sterile skim milk and heated to such temperatures for such periods of time as would prevent proliferation of the majority of the organisms under usual cultural conditions.

Most of the factors studied were without effect in the ranges employed upon the development to countable colonies of the unheated control bacteria; counts of heat-treated bacteria were affected, sometimes quite markedly, by modifications in the cultural conditions. Larger quantities of pep-

tone were more effective than small quantities in inducing development of maximum numbers of colonies. Addition of peptone to the basal medium before sterilization resulted in higher counts than did addition of a sterile peptone solution in equivalent quantity at the time the plates were poured, except when very small quantities were employed. Addition of thioglycollic acid to various media commonly resulted in rather large increases in count, a fairly definite optimum concentration of this substance being observed for each medium in the cases of the majority of the test organisms. A comparatively narrow pH range of the counting medium proved optimum for development of maximum numbers of colonies of heat-treated bacteria. This optimum was particularly pronounced with *E. coli* and *Ps. aeruginosa*, where it occurred at about pH 5.7. An incubation temperature of 32° C. proved optimum or nearly optimum for maximum count on most suspensions of heat-treated bacteria, with 28° and 37° C. being slightly less satisfactory in most instances and 42° C. being particularly unsatisfactory. Incubation at 21° C. commonly was very unsatisfactory when only 2 days were allowed for incubation, but incubation for 4 days greatly improved the results at this temperature, as well as improving the count level appreciably at 28° C. and to a smaller extent at 32° C. At 37° and 42° C. the longer incubation period had essentially no effect upon the count.

The data indicate all of the factors studied have an appreciable effect upon the apparent survival of bacteria subjected to sublethal heat, while being essentially without effect upon colony development of unheated control organisms from the same culture. Undoubtedly some of the observed differences in counts on pasteurized dairy products resulting from modifications of culture media and incubation conditions are due to the effect of these factors upon the ability of heat-treated bacteria to produce countable colonies, rather than because of growth of new strains or species of bacteria.

M2. A Correlation of the Resazurin Test Read with an All-Purpose Lovibond Comparator at 10, 30, and 60 Minutes with the Standard Plate Count of Milk. S. IRENE JORGENSEN AND N. S. GOLDING, *Washington Agricultural Experiment Station, Pullman, Wash.*

Extensive work has been done by the dairy research stations in Great Britain on the resazurin test for estimating the quality of farmer's milk. The color changes in this test have been standardized by a special Lovibond Comparator giving discs from blue, lilac, mauve, pink-purple, purple-pink, pink and white which are numbered 6, 5, 4, 3, 2, 1 and 0, respectively, and graded down from good to poor. The Ministry of Agriculture and Fisheries of Great Britain are recommending the resazurin test as a standard routine test and have issued a provisional technique for operating the test.

In our work to correlate the resazurin test with the Standard Plate Count (Standard Methods for the Examination of Dairy Products, American

Public Health Association, 8th Edition, 1941) we have used some 1360 samples of farmer's milk taken on the Portland, Oregon milk-shed in April and May, 1944. Standard plate counts were made by the Interstate Dairies in their laboratory and with their kind cooperation we obtained milk from each of these samples and made 30- and 60-minute resazurin readings on the comparator concurrently with their plate count.

Frequency curves for each resazurin disc number are plotted against the log of the standard plate count for thirty and for sixty minutes.

Previous work done during last winter in our laboratory including a smaller number of samples is expressed in a similar way for resazurin readings at 10, 30 and 60 minutes.

M3. Mastitis and the Plate Count. E. O. ANDERSON, W. N. PLASTRIDGE, AND H. W. SEELEY, JR., *Storrs Agricultural Experiment Station, Storrs, Conn.*

Our results seem to indicate that in general high bacterial counts in milk are due to causes other than the chronically infected cow's udder. A previous report showed that *Streptococcus agalactiae* counts in 33 samples of mixed herd milk averaged 1,100 bacterial colonies per ml. Recent work shows that the *Streptococcus uberis* population of 23 samples studied ranged from 30 to 40,000 bacterial colonies with an average of 8,200 per ml. Samples of milk drawn from 34 staphylococcus-infected quarters gave plate counts ranging from 200 to 42,000 staphylococcal colonies per ml. with an average of 6,800. Representative portions of the complete milking from seven chronically coli-infected quarters were plated on violet red bile agar and the plate counts were found to be less than 100 colonies per ml.

The region of 50° F. is critical for the growth of *Str. uberis* in milk. A statistical analysis disclosed that at this temperature 10 of 15 cultures showed a slight measurable increase in numbers during a 60-hour incubation period. Four of five cultures of *Str. agalactiae* did not grow at 50° F. under the same conditions.

M4. Behavior of Micro-Organisms in Fluid Dairy Products When Held in Atmosphere of Different Gases under Pressures. M. J. PRUCHA, *University of Illinois, Urbana, Ill.*

In this study milk and cream, both raw and pasteurized, were subjected to carbon dioxide, nitrous oxide and freon at different pressures and temperatures. Plate counts were made to determine the rate of multiplication of the bacteria present.

It was found that such treatment greatly reduced the rate of multiplication of bacteria. For example, in one test milk having a plate count of 10,000 and held at 50° F. had a count after four days of 31,000,000 while

the same milk subjected to 55 pounds pressure of nitrous oxide had a count of only 61,000.

In another test milk was inoculated with heat-resisting *E. coli* and was pasteurized at 130° F. for thirty minutes. The initial count was 7,000,000. The lot subjected to 100 pounds pressure of nitrous oxide was free from any *E. coli* while the lot not put under the pressure of the gas had a count of 44,000.

The effect of freon was about the same as that of nitrous oxide. The effect of carbon dioxide was more pronounced. When milk was subjected to air pressure and was then pasteurized, the pressure of 100 pounds also tended to cause a greater reduction of the number of bacteria by pasteurization.

A tentative conclusion of this study may be drawn to the effect that a combined effect of two or more harmful factors on microorganisms applied at the same time causes greater destruction of the microorganisms than the factors applied singly. This principle may become important in food preservation.

M6. Farm Sources of Oospora lactis.* E. R. GARRISON, *University of Missouri, Columbia, Mo.*

Qualitative determinations were made to detect the presence of *Oospora lactis* in dairy farm milk utensils and in various miscellaneous materials collected on farms. Quantitative determinations of this organism were usually not attempted because of the abundance of other molds in most materials examined, which overgrew and obscured the *Oospora lactis* colonies on the agar plates.

A portion of the inner surfaces of the milk utensils on 60 cream-producing farms were wiped, first with a moist, then with a dry cotton swab and the swabs and water (20 ml.) used were plated on acidified potato-dextrose agar and after incubation at room temperature the plates were examined for *Oospora lactis* colonies. Of the 60 milk pails, 23 milk strainers and 36 cream separators examined, 76.7, 65.2 and 80.6 per cent, respectively, contained *Oospora lactis*. Other molds were present, usually in relatively large numbers, on all equipment studied. The rubber parts of 20 milking machines were flushed with 500 ml. of sterile milk and the milk collected in a liter flask; after inoculating with butter culture, the flasks were held at a favorable temperature and observed for the growth of *Oospora lactis* in the cream on the surface of the milk; the rubber parts of only one machine yielded this organism.

Eighty-one samples of cistern water used for washing the milk utensils on dairy farms were analyzed for *Oospora lactis* by plating 1- and 5-ml.

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quantities in acidified potato-dextrose agar; this mold was found in 27 or 33.3 per cent of the water samples investigated.

The presence of *Oospora lactis* in the barn air was studied by exposing two sterile Petri dishes for 15 minutes at various places in 30 dairy barns under both clean and dusty conditions. One plate was later poured with acidified potato-dextrose agar while the other plate was poured with sterilized 10 per cent milk subsequently inoculated with butter culture and the plates then incubated to permit mold development. *Oospora lactis* was observed in only 4, or 6.7 per cent, of the 60 plates exposed.

The procedure followed for the detection of *Oospora lactis* in the miscellaneous materials examined was as follows: Quart and pint bottles one-half filled with milk were steamed for 30 minutes, then cooled to room temperature and inoculated with butter culture; approximately 5 grams of material to be studied were stirred into a quart bottle and approximately 1 gram of the same material was stirred into a pint bottle and the capped bottles were left undisturbed at room temperature for 3 to 5 days for the molds to grow; the presence of *Oospora lactis* in the cream on the surface of the milk could usually be accurately detected by macroscopic observation but a microscopic examination of the mold growth was always made for final verification.

The number of samples of each material examined by this procedure and the per cent of the samples in which *Oospora lactis* was found were as follows: barn floor dirt 13, 84.6 per cent; bedding 10, 60 per cent; brushings from cow 30, 83.3 per cent; barley and wheat 21, 28.6 per cent; corn 21, 19.1 per cent; cottonseed meal 11, 18.2 per cent; grain mixtures 37, 54.1 per cent; oats 20, 15 per cent; soybean meal 15, 6.7 per cent; alfalfa 15, 13.3 per cent; beet pulp 10, 20 per cent; lespedeza 33, 39.4 per cent; clover and timothy hay 15, 13.3 per cent; silage 43, 62.8 per cent; soybean hay 10, 10 per cent; straw 23, 17.4 per cent; fresh cow feces 91, 82.4 per cent; fresh horse feces 16, 87.5 per cent; barnyard soil 45, 75.6 per cent; field and garden soil 42, 28.6 per cent.

Thirty samples of fresh cow feces plated on acidified potato-dextrose agar gave *Oospora lactis* counts of less than 1 per gm. in 2 samples and over 10,000 per gm. in 5 samples with a maximum count of 34,000 per gm.

M8. The Mold Mycelia Count as an Index of Quality of Butter. P. R. Elliker and B. E. Horrall, *Purdue University Agricultural Experiment Station, West Lafayette, Ind.*

This study was based on results of mold mycelia counts and scores (organoleptic grade) on 1,385 commercial butter samples obtained monthly over a three-year period from Indiana and surrounding region.

No 92 score butter was illegal (mold mycelia counts over 60 per cent) in any of the four seasons of the year. During the winter period practically

no 89 or 90 score and about 20 per cent of the cooking grade butter was illegal. The spring period was similar except that some increase in illegal butters occurred in the 89 score group. In the summer period about 30 per cent of the 90, 60 per cent of the 89 and 75 per cent of the cooking grade butter was illegal. In the fall period about 11 per cent of the 90 score, 18 per cent 89 score and about 73 per cent of the cooking grade butter was illegal. According to organoleptic tests, actual quality of butter remained reasonably constant throughout the year with slightly more poor quality butter in the fall months, but mold content of butter soared to high levels in the summer and then gradually receded to a low level with colder weather. By mold mycelia standards over the entire period studied, about 50 per cent of all cooking grade butter, about 25 per cent of 89 score (commercial number 2 grade), about 10 per cent of 90 score and none of the 92 score butter would have been considered illegal.

Results indicate that organoleptic grade of cream and butter should be emphasized above other available quality tests if actual quality of commercial butter is to be improved in the area studied.

M9. An Aerobacter Species in Whey Cream as a Cause of a Medicinal Flavor Encountered in Butter. T. J. CLAYDON, *University of Arkansas, Fayetteville, Ark.*

During a two-year period at the University of Arkansas Creamery, a number of churnings of commercial butter were encountered that exhibited a definite medicinal flavor. The defect varied in intensity from slight to very disagreeable. Whey cream, occasionally used for a portion of the fat, was found to be the source of the flavor. While not all whey cream was affected, some lots showed the typical medicinal flavor encountered in the butter. The odor was also suggestive of the defect. The condition was observed at various times in whey cream from three separate cheese plants. Inspection of one of the plants failed to indicate the cause. Fly spray and chlorine compounds did not appear to be involved, although laboratory tests suggested the latter as a possibility.

During this time an outbreak of a medicinal flavor in market milk was encountered and traced to *Aerobacter aerogenes*. Laboratory cheese-making trials showed that, under certain conditions, this organism would produce the medicinal flavor and odor in whey. The defect was more intense in the whey cream and resulting butter.

Although first attempts to isolate *A. aerogenes* from slightly defective whey cream were unsuccessful, examinations of later shipments yielded considerable numbers of organisms of the *Aerobacter* group. This organism inoculated into milk set for cheese-making, frequently produced a medicinal flavor and odor in whey after the latter was held several hours at room temperature. Increased development of acid masked the defect. Butter made from the whey cream was characterized by the medicinal defect.

Preliminary studies indicated the organism to be *A. aerogenes*, which is common in raw milk and to a considerable extent in pasteurized cheese. Possible phenol production by the organism, under some conditions, might account for the medicinal flavor.

M10. Some Chemical and Physical Properties of Washing Powders. P. S. LUCAS, *Michigan State College, East Lansing, Mich.*

In the following report 13 commercial washing powders, one acid cleaner, three single chemical detergents, and two wetting agents were checked for some of their chemical properties as related to bottle and can washing adaptability. The cost of bottle washing economy in terms of water and alkali required under varying conditions was calculated.

In total alkalinity, active caustic strength, and soda ash content these cleaners varied from neutral to high values. Several had high buffer values as determined by pH determinations made after successive additions of standard acid, but the tendency of manufacturers compounding washing mixtures, except for bottle washing, has been to depend less upon alkalinity than upon reduction of surface tension through addition of wetting agents for cleansing value in their product.

The amounts of water and alkali required to wash a milk bottle depend upon the frequency with which the washing solution is changed, and whether the strength of the solution is maintained at a constant value. Of the two the water used is but slightly affected, the amount varying from 0.8 to 0.95 gallons of soft water per quart bottle equivalent washed. The amount of alkali used in soft water is greatly affected. In 26- and 33-day trials one pound alkali was sufficient for 222 and 333 bottles, respectively. In a 14-day trial, with one initial charge only, one pound washed but 189 quart bottles. In this trial total alkalinity decreased from 4.05 to 3.1 per cent and pH from 11.2 to 10.75. However, when the washing solution was changed only after 68 days one pound of alkali was sufficient to wash 476 bottles.

M11. Factors Entering into the Testing of Sour Cream for Extraneous Matter. KENNETH M. RENNER, *Texas Technological College, Lubbock, Tex.*

Recently a number of creameries located in the Southwestern section of the United States have found it desirable to make sediment tests on sour cream, using a four-ounce sample instead of the two-ounce sample formerly in general use throughout the country.

It was found that entirely too many of the four-ounce samples refused to filter completely when the methods of sediment testing commonly used for the two-ounce sample were applied to the larger size sample.

Various factors entering into the testing of sour cream for extraneous matter were studied in order to determine their effect on the ability to secure complete filtration of four-ounce samples of cream.

The following sediment tests, recently published by the American Butter Institute, were used:

Method 1—Soda Solution Method (Illinois Method).

Method 2—Dry Soda Method.

Method 3—Acid Method (HCL Method recommended by Prof. M. G. Pederson, Texas Technological College).
(HCL Method recommended by Prof. B. A. Horrall, Purdue University).

Method 4—Texas Tech. Method (Calgon-Diversey U,S,N,-Citric Acid) Recommended by Prof. K. M. Renner, Texas Technological College.

Method 5—Special Solution, designated by the Manufacturer as X–300.

The following factors were found to have a direct influence on the ability to secure complete filtration of four-ounce samples of sour cream in testing for extraneous matter:

1. The hardness of the water used in the test.
2. The percentage of butterfat in the cream.
3. The age of the cream.
4. The physical condition of the cream (curd content).
5. The method of adding the testing solutions to the cream.

No one method of testing four-ounce samples of cream for extraneous matter was found which would work one hundred per cent. A new method of filtering cream to determine the amount of extraneous matter in cream has been developed by the Department of Dairy Manufactures, Texas Technological College, which appears to be approximately 95 per cent effective under the conditions studied. Certain methods which had previously been successful in the filtering of two-ounce samples of cream would not work on four-ounce samples.

M12. The Problem of Extraneous Matter in Cheddar Cheese. WALTER V. PRICE AND RAYMOND MIERSCH, *University of Wisconsin, Madison, Wis.*

The test for extraneous matter in cheese provides a method of detecting the use of unclean milk and unsanitary factory conditions, and a means of demonstrating the necessity of strict sanitation. When milk is efficiently filtered the test becomes useless to check farm practices. A low-power microscope must be used to identify sediment of animal or insect origin.

Distribution of extraneous matter is fairly uniform in a single cheddar but from cheese to cheese from a single vat it is not uniform. Cheese from any source should be tested regularly and frequently as a control measure.

The test can be used systematically to improve cheese factory operations if the control chart system of inspecting the quality of a manufactured product is applied. By this method (which is described in principle by L. E. Simon, "An Engineer's Manual of Statistical Methods," John Wiley, 1941) 60 consecutive daily tests provide data to describe factory performance. The control chart provides a working guide based on factory performance and indicates variations in quality in time to correct errors *before* rejections are necessary. Specifications can be written with suitable statistical considerations in mind so that a quality improvement program can be initiated even though it is impractical as yet to set industrial standards or tolerances.

The justification of this plan is based on the conviction that it is unreasonable to expect perfect sediment tests in cheese. Observations and data indicate that where it is necessary the elimination of excessive amounts of extraneous matter from cheese is practical; the reduction of contamination with undesirable types of foreign matter in the factory is possible; and that costs of doing so should not be prohibitive.

M14. Use of Conductivity Measurements for Detecting Neutralization of Buttermilk. S. T. COULTER AND R. W. KUNKEL, *University of Minnesota, St. Paul, Minn.*

Large quantities of dry buttermilk are manufactured in central drying plants which purchase the buttermilk from outlying creameries. Many of these plants manufacture dry sweet cream buttermilk. Some rapid method of analysis which would detect the addition of neutralizer to the cream from which the buttermilk was churned should be of assistance.

The alkalinity of the ash has been used as an index of neutralization in dry buttermilk. Based on the analyses of 114 samples of dry buttermilk ranging in ash alkalinity from 78 to 524, the conductivity of the reconstituted buttermilk increases directly with increase in ash alkalinity. The conductivity measurements ranged from 53.3 to 79.8×10^{-4} mhos at 25° C. The correlation coefficient between the two sets of data was 0.94.

This test has been used with fluid buttermilk and appears to be a useful tool for grading buttermilk in central drying plants. A suitable correction must be made for dilution of the buttermilk.

M13. Correlating Lactic Acid Determinations with Practical Milk Quality Tests in Grading Milk for Manufactured Dairy Products. I. A. GOULD AND J. M. JENSEN, *Michigan State College, East Lansing, Mich.*

The lactic acid content of condensed and dried milk reflects the quality of the milk which is used in the manufacture of these products. However, since the direct application of lactic acid determinations to raw milk as a routine grading test is impractical, a study was conducted with the view of

correlating the lactic acid results with more practical milk quality tests. Trials were conducted in which raw milk from various sources was incubated either at 25° C. or 35° C. and examined at intervals for (a) lactic acid by the Hillig colorimetric method, (b) acid associated flavors, (c) titrable acidity, (d) direct microscopic clump counts, (e) methylene blue reduction. Acid associated flavors were usually detected at lactic acid increases of 2–5 mg./100 grams and pronounced acid-type flavors resulted when the lactic acid increase amounted to 10 mg./100 grams or more. Microscopic clump counts varied widely with specific increases in lactic acid although a general direct relationship existed. Of the samples with lactic acid increases of 1–2 mg./100 grams, 72.4 per cent of the samples possessed bacterial counts of less than 5 million. Acid associated flavors often resulted with bacterial counts of 2 million per ml. The original milk usually had bacterial counts below 50,000 per ml. Methylene blue reduction time was in general directly related to the lactic acid content of the milk but a production of 5 mg./100 grams or more was required before the reduction time was consistently under one hour. On the average, titrable acidities agreed closely with the lactic acid results but determinations on individual samples varied widely. Differences in the types and strains of the predominant bacteria in the milk may influence the relationship between the lactic acid content and these various practical quality tests.

M15. An Improved Technique for the Determination of the Volatile Acidity of Cheese. K. L. Smiley and A. C. Dahlberg, *Cornell University, Ithaca, N. Y.*

A method was developed for the determination of volatile acids in cheese. Cheese was ground in a 10 per cent phosphoric acid solution and the resulting mush was extracted repeatedly with ether in the presence of magnesium sulfate. The fatty acids were liberated from the ether solution by repeated washings with 0.1 N NaOH. All traces of ether were evaporated from the combined alkaline washings on an electric hot plate. The washings were then acidified to pH 2.0 and distilled in the presence of $MgSO_4$. The distillate was filtered through paper to separate the soluble from the insoluble acids. The soluble acids were titrated directly, using phenolphthalein. Neutral alcohol was used to rinse the condenser and dissolve the insoluble acids on the filter paper. The alcoholic solution was then titrated and the sum of the two titrations equals the volatile acidity of the cheese.

An ordinary Kjeldahl distillation outfit without traps was used for a condenser. Since the volatile acids are quantitatively distilled in the presence of $MgSO_4$, a perfectly uniform apparatus is not necessary.

The method gave uniform results for all samples of cheese and the results agree very well with values obtained using the method of Hiscox, Harrison, and Wolf. It has two advantages over the latter method in that no special apparatus is necessary and the time required is greatly reduced.

M16. A Study of Some of the Substances Absorbed on the Fat Globules of Milk. ROBERT JENNESS, *University of Minnesota, St. Paul, Minn.*

This study was undertaken to ascertain whether large variations in proportions of protein, phospholipide, and phosphorus-free lipide such as were found in natural "membranes" by Rimpila and Palmer (1935) could be correlated with such natural factors as breed of cow, season, ration, or stage of lactation. The method consisted of precipitation of the "membrane" protein from washed cream with dioxan and determination of lipide phosphorus in either the dioxan or Roese-Gottlieb extracts. Ranges of 0.459–0.862 gm. protein and 8.9–16.4 mgm. lipide phosphorus per 100 gm. fat were found in creams that had been washed 6 times at 105–100° F. The levels were relatively constant for any given group of cows, being lower in Jersey than in Holstein creams. The ratio of protein/phospholipide varied from 1.8 to 2.3 in 13 creams, being 2.7 in the fourteenth. It was calculated that 3.4–4.9 μg. protein and 0.57–0.86 μg. lipide phosphorus were adsorbed per 100 cm.^{2} of fat surface.

The distribution of protein and phospholipide between washed cream buttermilk and butter plasma was followed by precipitating the protein with dioxan and determining lipide phosphorus in the dioxan extract. The ratio of protein/phospholipide was 2.4 to 3.8 in 11 samples of buttermilk and 1.0 to 2.0 in the corresponding butter plasmas. A rather constant retention in the butter plasma of protein at a level of 0.21–0.30 gm. per 100 gm. fat was noted regardless of concentration of fat or of protein in the unchurned washed cream. The level of phospholipide retained by the butter plasma was not constant but tended to vary directly with the level in the washed cream.

The presence in "membrane" preparations of the high melting triglyceride fraction noted by Palmer and Wiese (1933) was confirmed. Fractions of nearly identical properties were crystallized from alcohol extracts of washed cream buttermilk, and butter plasma and from alcohol solutions of butterfat. This material constituted a greater percentage of the phosphorus-free extract of butter plasma than of that of buttermilk or of butterfat itself.

These findings appear to be best explained by considering that the "membrane" consists of a lecithoprotein complex with phospholipides oriented to the fat phase and protein to the aqueous phase. Churning evidently involves "erosion" of protein to a critical level, the complex being disrupted in such a manner as to release a comparatively protein-rich portion to the free buttermilk. Upon melting the butter, the butter plasma is enriched in the higher melting fat fraction probably as a result of a special affinity of the "membrane" for it.

M17. Some Factors Affecting the Inversion of Sucrose. T. R. FREEMAN AND E. L. FOUTS, *University of Florida, Gainesville, Fla.*

Discussions in the literature regarding the relative sweetness of invert sugar indicate widespread disagreement and confusion on this subject. It has been tacitly assumed in all theoretical discussions that acid hydrolysis of sucrose by boiling in a water solution produces equal quantities of dextrose and levulose. It is also generally assumed that the sucrose is completely hydrolyzed. Both of these assumptions are erroneous. The present study was undertaken to obtain some basic information which might help eliminate, or at least account for, some of the divergent views regarding the sweetening power of invert sugar.

The effect on the inversion of sucrose of the kind and amount of acid employed has been studied. Tartaric, citric, lactic, acetic, hydrochloric, sulfuric, and phosphoric acids were included. A series of sirups was prepared with each acid, varying the amount of acid in such manner as to obtain pH values within the approximate range of 3.5 to 1.5. The resulting invert sirups were analyzed quantitatively for dextrose and levulose, using the "iodine-oxidation" method described by Lathrop and Holmes (Indus. and Engin. Chem., Analyt. Ed., **3**: 334–339. 1931).

It has been observed that, in general, the most complete inversion of the sucrose occurs within the pH range of 2.5–2.0. The optimum pH for each acid and the degree to which the sucrose was hydrolyzed may be indicated as follows: tartaric, pH 2.09, 96.0 per cent; citric, pH 2.15, 95.1 per cent; lactic, pH 2.23, 95.0 per cent; acetic, pH 2.20, 98.4 per cent; HCl, pH 2.63, 95.3 per cent; H_2SO_4, pH 2.43, 95.3 per cent; H_3PO_4, pH 1.85, 93.4 per cent.

The invert sugars thus produced contained 41.1 to 51.1 per cent levulose. The effect of kind and amount of acid on ratio of dextrose to levulose in the resulting invert sugar was inconsistent. The pH which produced the most favorable ratio of levulose to dextrose, and the per cent levulose in the invert sugar, are indicated as follows for each acid: tartaric, pH 3.20, 48.5 per cent; citric, pH 3.41, 50.0 per cent; lactic, pH 2.68, 48.3 per cent; acetic, pH 2.20, 50.8 per cent; HCl, pH 2.63, 48.4 per cent; H_2SO_4, pH 3.20, 51.1 per cent; H_3PO_4, pH 3.24, 48.6 per cent. With only two of the acids used (acetic and hydrochloric) was the best ratio of levulose to dextrose obtained at the same pH which resulted in the maximum production of invert sugar.

Tartaric, citric, lactic, hydrochloric, and sulfuric acids gave satisfactory inversion of the sucrose. Phosphoric acid is a somewhat less efficient catalyst than the other acids studied. Although acetic acid gave the highest yield of invert sugar, and a very favorable ratio of levulose to dextrose, its use is impractical because of the unpleasant odor imparted to the sirup.

Preliminary trials indicate that the proportion of sugar to water used in preparing invert sirup affects hydrolysis of the sucrose. The yield of invert sugar and the per cent levulose in the invert sugar both increase as

the water content of the unboiled sirup is increased progressively from 27.8 per cent to 39.8 per cent.

M18. Study of the Peroxide Value of Stored Spray-Dried Whole Milk Powder. HARRY PYENSON AND P. H. TRACY, *University of Illinois, Urbana, Ill.*, AND J. M. TRIMBLE, *Indiana Condensed Milk Company, Indianapolis, Ind.*

Approximately 180 samples of spray-dried whole milk powder stored at room temperature and varying in age from fresh to 21 months were analyzed for peroxide content, gas content and scored for flavor. The variables included antioxidant addition, packing temperature, spray chamber temperature, spray pressure, spray temperature, pre-heat temperature, packing temperature, homogenization pressure and temperature, copper addition, neutralization, time of packing, and gas packing.

There were cases where both fresh spray-dried whole milk powder and oxidized samples several months old had a low peroxide value. Other observations showed that some whole milk powder gave a peroxide value but lacked oxidized flavor. There was no correlation between peroxide content of plain-packed and nitrogen-packed whole milk powder and the extent of oxidized flavor development. Some of the whole milk powder studied, although lacking in peroxide content, produced an oxidized flavor.

With the exception of one set of four samples 18 months old, the highest peroxide value obtained on any of the 180 samples was 15.07 milliequivalents of peroxide per kilogram of milk powder. Since in general high peroxide values were not obtained it is concluded that side reactions take place as the peroxides form producing other compounds such as aldehydes, ketones and keto-hydroxy compounds. It was also noted that the peroxide values were low in most of those samples which showed little or no oxygen. The data indicate that it is possible, especially in the case of fresh whole milk powder, to obtain a reducing action resulting in a "negative" peroxide value.

On the basis of the results obtained with the Chapman and McFarlane (Canadian Journal of Research, B, **21**: 133–139. 1943) method for the determination of peroxides in whole milk powder, it is concluded that peroxide value is not a satisfactory criterion of the palatability or keeping quality of spray-dried whole milk powder.

M19. The Determination of Lipase from Milk Extracted with Acetone and Ether. PHILIP L. KELLY, *University of Arkansas, Fayetteville, Ark.*

Dried defatted milk was obtained by extracting one volume of milk twice with acetone, once with equal parts of acetone and ether and twice with ether each time using five volumes of solvent. A soft white precipitate was obtained which will keep indefinitely. Since it contained only 5 or 6 per cent moisture the milk and substrate were used alone without preservative. Some

of the samples were immediately extracted with ether to serve as blanks, the remainder were incubated at 37° C., usually for 24 hours, before extraction. Alcohol was added to the extract which was titrated against aqueous N/10 sodium hydroxide using phenolphthalein as the indicator. A sufficient amount of substrate was added to completely moisten the milk or similar results were obtained by adding a 20 per cent solution of the substrate in ether, later allowing the ether to evaporate.

Samples of dried cream showed considerably higher lipase activity than did samples of whole or skimmed milk. When milk was held in a refrigerator 24 hours before drying the lipase activity increased from 20 to 80 per cent indicating that the age of the milk is an important factor in comparative studies.

Tributyrin, diacetin, triacetin, tricaproin, trimyristin, ethyl-oleate, tripalmitin and sterilized butter oil were used as substrates, both with normal milk and with milk which developed rancidity. Series were made up of from 4 to 20 samples. Results were expressed as the average increase in titration per gram of dried milk used in a 24-hour incubation period.

With tributyrin the data were obtained from 9 series with normal milk and 12 series from milk developing rancidity. The normal series showed titrations from 0.03 to 0.25 ml. The rancid series showed titrations from 0.30 to 1.40.

The three normal series with tricaprion produced titrations from 0.08 to 0.10 while the one series with milk developing rancidity gave a titration of 0.16.

The triacetin samples in three normal series varied from 0.15 to 0.26 while the three rancid series ranged from 0.36 to 0.69. There seemed to be no significant differences, nor any consistency in the results when diacetin was the substrate. This was also true when ethyl-oleate was the substrate. Although four series were carried out with trimyristin there was no evidence showing that this was hydrolyzed by milk lipase.

With tripalmitin two series with normal milk showed titration of 0.07, and two series with rancid milk titrations of 0.08 and 0.19.

When butter oil was the substrate, two series with normal milk gave values of 0.05 to 0.08 while the four using milk which developed rancidity showed titrations of 0.10 to 0.12.

The milk which showed development of rancidity indicated a selective hydrolysis with the short chain triglycerides hydrolyzed to a much greater extent than with the long chain triglycerides.

M20. The Influence of Butter Cultures and of Butter Flavors on the Quality of Butter. H. C. Olson and P. E. Johnson, *Oklahoma A. and M. College, Stillwater, Okla.*

Several series of churnings were made to compare the flavor and keeping quality of butter made with (1) butter flavors added to the butter, (2)

butter culture incorporated into the butter, (3) butter culture added to the cream, and (4) control churning with nothing added to either cream or butter. Samples of both salted and of unsalted butter from each churning were held at about 45° F. and at – 5° F. Flavor score and diacetyl determinations were made on the samples at various intervals.

The use of either butter culture or of butter flavors improved the flavor of fresh butter. Butter culture was superior to the butter flavors in improving the fresh flavor of butter. Adding the butter culture directly to the butter resulted in a more pleasing fresh flavor than was obtained by adding the culture to the cream, although the average diacetyl content of the former was not as high. The diacetyl content of the butter made with culture added to the cream or with culture incorporated into the butter increased during the first week or two of storage and then decreased gradually throughout the remainder of the storage period at 45° F. The increase was much greater with the unsalted butter into which butter culture had been incorporated than with any of the other samples. The diacetyl content of the butter made with butter flavors added decreased during storage, the most rapid decrease occurring with the unsalted samples during the first week of storage. Considerable variation occurred among various commercial butter flavors in their ability to impart a desirable flavor and to retain their flavor in butter.

The butter made with culture added to the cream had better keeping qualities than any of the other lots.

M21. Effect of Various Bacteria on Diacetyl Content and Flavor of Butter. P. R. ELLIKER, *Purdue University Agricultural Experiment Station, West Lafayette, Ind.*

A modification of the Pien, Baisse, and Martin orthodiaminobenzidine hydrochloride method for diacetyl determination proved accurate, highly sensitive and rapid and consequently was employed throughout this investigation.

A wide variety of bacteria, including several different genera, were able to destroy diacetyl added to milk. *Streptococcus lactis* exerted no effect on diacetyl under the same conditions. A number of butter-spoilage organisms, including *Pseudomonas fluorescens, Pseudomonas fluorescens liquefaciens, Pseudomonas fragi, Pseudomonas putrefaciens, Pseudomonas nigrifaciens,* and some unidentified non-pigmented species of *Pseudomonas,* markedly reduced the diacetyl content of experimental butters under controlled conditions at 15.6° C. (60° F.). Again *Str. lactis* did not affect the diacetyl content under similar conditions. Almost all of the diacetyl destroyed by *Ps. putrefaciens* during 10 days of growth in butter stored at 15.6° C. could be recovered as acetylmethylcarbinol and 2, 3-butylene glycol. About three-fourths of that recovered was present as acetylmethylcarbinol and one-fourth as butylene glycol.

Commercial butters known to consistently carry large numbers of bacteria of the *Ps. putrefaciens* type rapidly lost diacetyl and aroma during keeping-quality tests.

Results indicated that the factor responsible for inhibition of *Pseudomonas* species by butter starters in butter was *Str. lactis* or related bacteria rather than diacetyl.

M22. The Effect of Storage Temperature on the Keeping Quality of Butter. C. N. STARK, J. J. R. CAMPBELL, AND E. S. GUTHRIE, *Cornell University, Ithaca, N. Y.*

Reports from this laboratory and unpublished data, as well as practical plant experience, have shown that the more important butter-spoilage factors are: (1) natural milk enzymes; (2) harmful bacteria; (3) salt; and (4) acid. The best-keeping butter is made from high quality, sweet cream which has been pasteurized at 165° F. for 30 minutes (or an equivalent heat treatment); it is unsalted and not recontaminated with harmful bacteria during the buttermaking process. If several of the above-mentioned spoilage factors are present, their combined effect as well as the effect of each of these factors upon the other, make more difficult the correct evaluation of the part played by each of these factors.

Much of the present excellent keeping quality of butter is made possible because the butter is usually stored in a frozen condition, where microorganisms cannot grow and chemical spoilage rates are retarded. These experiments, the results of which are being reported here, were conducted to obtain more information on the significance of storage temperatures upon the keeping quality of butter.

It was assumed that commercial butter should be stored at or below freezing temperature. Many tests were made but the importance of storage of butter at or below 0° F. was definitely shown. For example, similar butters (sweet cream, pasteurized at 165° F. for 30 minutes, unsalted) stored at 0° F. and 32° F. respectively had the following scores: fresh, 95 and 95; stored 6 months, 93 and 93; stored 8 months, 93 and 91; stored one year, 93 and 83. The absence of appreciable numbers of microorganisms in the butter stored at 32° F. shows that microorganisms were not responsible for the spoilage of the butter stored at 32° F.

A long series of tests made in the Cornell Laboratories has shown such butter stored for as long as 8 years at 0° F. to score 92. These findings confirm the practice of 0° F. storage temperatures for commercial butter.

M23. Butter Studies: Knaysi Method vs. Titration of Fatty Acids in Butter. E. S. GUTHRIE, *Cornell University, Ithaca, N. Y.*

Neither method can replace judging. Of the 378 samples the Knaysi reading correlated more closely with the judging in 20 cases than did the

titration procedure. And it was evident in 22 cases that the titration procedure was closer to the judging than the Knaysi method. In 8 cases there was poor correlation between both methods and judging. These methods, therefore, correlate closely with each other and both agree with judging in the great majority of cases.

Difference in score of Interior and surface. The interior score of 378 samples of butter purchased from the open market was 91 with a range from 87–93, whereas the surface score was about 87 with a range from 83–92.

M24. Action of Lipase from Various Sources on the Fat of Cheddar Cheese. F. J. BABEL, *Iowa Agricultural Experiment Station, Ames, Ia.*

The fat acidities of cheddar cheese made from pasteurized milk, without addition of lipase, increased at a rather regular rate during the ripening period. The results did not indicate a more rapid breakdown of the fat late in the ripening. The variations encountered in the fat acidities with the different lots of cheese could not be correlated with the pH of the cheese, the acidity of the whey at milling, or the moisture or fat contents of the cheese.

Cheese made with small amounts of rennet paste showed definite increases in fat acidities over those of the control cheese. The cheese either did not develop a rancid flavor or the rancid flavor disappeared during the ripening. The addition of small amounts of rennet paste appeared to overcome the sour or acid flavor frequently encountered in pasteurized milk cheese. Larger amounts of rennet paste resulted in greater increases in the fat acidities although variations were encountered. With the larger amounts, the cheese developed a rancid flavor and this was usually evident throughout the ripening; however, in some cases the rancid flavor appeared to decrease in intensity as the cheese became older.

Cheese made with small amounts of mulberry juice added to the milk either did not increase in fat acidity or only slightly increased. The small amounts did not produce a rancid flavor in the cheese and the cheese were very similar to the control cheese. Larger amounts of mulberry juice resulted in considerably greater increases in fat acidities; however, variations were encountered with different lots of cheese and different lots of mulberries. The rancid flavor of the cheese made with mulberry juice did not appear to decrease in intensity as the cheese became older. Unclean and rancid flavors were frequently encountered. In practically all cases, the cheese made with added mulberry juice was considered inferior to the control cheese.

M25. Combining Lactic and Bulgaricus Fermentation in Cheese-Making to Prevent Gas Formation in Cheese-Ripening. N. S. GOLDING, *Washington Agricultural Experiment Station, Pullman, Wash.*

For the successful vacuum canning of cheese, it is essential that the

freshly canned cheese do not produce sufficient gas during the ripening process to bulge the cans. We have found that when the starter rapidly produced acid during the making process, subsequent gas production during ripening is slight. In contrast, when the starter failed to produce acid actively during making, sufficient gas to bulge the ends of the cans was produced at ripening temperatures from 40° F. to 50° F. Of 270 cans of cheese made by the cheddar process, 13.5 per cent produced sufficient gas to be at atmospheric pressure or higher when mature. The more complete the failure of the lactic fermentation and the higher the temperature of ripening, the more rapidly gas formation occurred during ripening. Also, it was found that different commercial lactic starters for cheese-making changed materially the rate of production of gas when the cheeses were ripened under the same conditions.

Lactobacillus bulgaricus, which readily grows in milk and rapidly utilizes lactose with the production of a high degree of acid, but with no gas, was obtained as a commercial starter. This starter and a commercial lactic starter were used together in the manufacture of cheese having a setting-to-milling time of from 4.5 to 5 hours and an acidity at milling of 0.5 per cent. In all cases, the addition of the *bulgaricus* starter resulted in less gas being produced in the mature can of cheese; the greater the proportion of *bulgaricus* starter used, the less the amount of gas produced. The mature cheese made with the combined starters do not have a typical cheddar flavor, but possess a clean, sweet flavor which is acceptable to many people. The texture was that of a Cheshire cheese and the color was usually uneven. The mature cheese withstands adverse storage conditions of 55° and 65° F., frequently encountered in retail stores, as little or no gas was produced at these temperatures during a period of 50 days. Experiments now under way include methods for determining to what extent the lactic and *bulgaricus* starters develop during the making process as follows:

a. The amount of acidity produced in the milk by each starter by holding it at the cheese-making temperatures in sterile containers and determining the per cent of acidity at dipping and milling.
b. Dilution counts in milk incubated at 21° C. and 37° C.
c. Plate counts on tryptone glucose extract agar incubated at 20° C., and Baltimore Biological Laboratories anaerobic agar incubated at 37° C.
d. Microscopic counts by a modification of the Breed method. Cheese of 2041 grams each were canned the day after manufacturing in No. 10, 5″ cans and ripened at three different temperatures; namely, 45° F., 55° F., and 65° F.

The results thus far obtained over a period of 50 days (a period which has previously represented more than half the gas formed during ripening) show:

a. With lactic starter and little or no *bulgaricus* starter, the average drop in vacuum was 10, 7½ and 6 inches of mercury for temperatures of 65, 55, and 45° F., respectively.
b. With lactic and *bulgaricus* starters added in equal proportion, the average drop in vacuum was 3, 3, and 2¾ inches of mercury for temperatures of 65, 55, and 45° F., respectively.
c. With *bulgaricus* starter only, the average drop in vacuum was ¾, 1¼ and 1½ inches of mercury for temperatures of 65, 55, and 45° F., respectively. Thus far, these results are in agreement with our previous work.

M27. Effect of Heat Treatments of Milk on Quality and Ripening of Cheddar Cheese. A. O. CALL AND W. V. PRICE, *University of Wisconsin, Madison, Wis.*

The Cheddar cheese for these experiments was made between October, 1942, and June, 1943. Each experimental group of cheese included four lots made from identical milk; one lot of cheese was always made from raw milk, one from milk pasteurized at 160° F. for 15.6 seconds and the other two lots from portions of the milk which had been subjected to some other heat treatments. The Cherry-Burrell Fine-line, Continuous Pasteurizer was used for all short-time heat treatments. The cheese was scored at 1, 3, 6 and 12 months by several judges and was analyzed for water-soluble nitrogen and amino nitrogen contents at the ages of 3, 6 and 12 months.

Since the final analyses have just been completed it is possible to present only a preliminary report on the results. The data confirm the conclusions of former studies by many workers who have shown the value of proper pasteurization for improving the quality and uniformity of Cheddar cheese. Heat treatments of milk which exceed or fail to meet pasteurizing requirements produce cheese which is intermediate in quality between raw-milk and properly-pasteurized-milk cheese.

The amounts of nitrogen in the cheese in the water-soluble and amino nitrogen forms vary with the severity of the heat treatment and with the age of the cheese. These values are more uniform during the curing of pasteurized-milk cheese. There seems to be a tendency for these values to increase as the quality of the raw-milk cheese decreases but they do not seem to be so closely related to the quality of cheese made from heated milk.

In these experiments heat treatments which approximated true pasteurization produced the effects of usual pasteurizing heat treatments.

M28. Relation of Corn and Alfalfa Silage to the Quality of Cheese and Its Carotene and Vitamin-A Content. W. V. PRICE, K. HIGUCHI, AND W. H. PETERSON, *University of Wisconsin, Madison, Wis.*

The milks from three groups of cows were made simultaneously into

cheese. The rations of these groups differed only in the type of silage which each received; one group (I) was fed corn silage, the second (II) half corn and half alfalfa silage and the third (III) alfalfa silage.* The complete milkings in the evening and morning were combined for these cheese-making experiments. All lots of milk contained less than 15,000 organisms per ml. when placed in the cheese vats. The cheese was made on eight different days during the months of January and February, 1944. All lots of cheese were paraffined, cured at 40° F., and scored at 3 months of age by three judges.

The flavor scores for lots I, II, and III averaged 37.5, 37.9 and 38.0, respectively; listed in the same order, body and texture scores averaged 28.0, 28.4 and 28.3; while total scores averaged 90.4, 91.2 and 91.3. Such small differences in quality in favor of the milk from alfalfa-silage-fed cows are noteworthy because they tend to refute, at least for cheddar cheese, the notion of some practical cheesemakers that alfalfa silage cannot be fed without causing defective cheese. No differences were observed in manufacturing procedures for these three lots of milk.

All whey was saved from each vat; to each lot of whey was added one-third of the press drippings from all three lots of cheese and this mixture was used for measuring carotene and vitamin-A distribution in the making process. Cheese was sampled for analysis as it was removed from the press, again at 8 weeks and finally at 12 weeks after making.

The carotene and vitamin-A content of each lot of cheese paralleled the values found for the milk from which it was made. There was no destruction of carotene and vitamin A during a 12-week curing period. At the end of this time the micrograms of carotene per gram of cheese for lots I, II and III were 1.58, 1.88 and 1.85, respectively. The corresponding figures for vitamin A were 1.84, 1.98 and 2.28. About 85 per cent of the carotene and vitamin A in the milk was recovered in the cheese, 7 per cent was left in the whey and 8 per cent was not accounted for.

M29. Two Years' Experience in Deaerating Milk. E. S. GUTHRIE, *Cornell University, Ithaca, N. Y.*

Taking April, 1943, as a typical month for intensive oxidized flavors in milk, the scores were as follows: fresh milk, not deaerated, 40; deaerated milk that was put in the bottle by the in-bottom filling procedure, not under vacuum, 39 on the 7th day; deaerated milk which was conveyed to the bottle by a commercial filler, not under vacuum, 36 on the 7th day; and the control sample that was not deaerated, 31 on the 7th day.

In April, 1943, the vitamin C dropped from 18.24 milligrams per liter of the original milk to 16.89 in the in-bottom sample that was held 7 days.

* J. J. Stefaniak, I. W. Rupel, and W. H. Peterson. "Effect of feeding corn and alfalfa silages on the fat- and water-soluble vitamins of winter milk." Proceedings of the 39th Annual Meeting, American Dairy Science Association, Columbus, Ohio, June, 1944.

The vitamin C in the commercially filled bottles was 15.32 milligrams on the 7th day, and the control sample that was not deaerated was down to 7.74 on the 7th day.

During the period of over 2 years of eliminating almost all of the oxygen from the milk on a commercial basis, the consumers have not complained about the oxidized flavors; whereas, previous to the installation of the deaerating equipment, these flavors were the cause of much consumer criticism.

M30. The Relationship of the Individuality of the Cow to the Production of Rancid Milk. W. A. KRIENKE, *Oklahoma A. and M. College, Stillwater, Okla.*

Individual samples of milk were taken from each producing cow in the college dairy herd at two-week intervals during 1942 and at monthly intervals during 1943. All samples were cooled in ice water immediately after milking and held at about 38° F. for one day and for three days. The samples were then examined organoleptically for the rancid flavor and odor.

A high percentage of the cows were found to produce rancid milk during this period; some were very persistent in producing it while others produced it occasionally and at irregular intervals. Several cows produced the defect at the beginning of their lactation periods while others produced it only at the end. Rancid milk was produced by some cows at the beginning and at the end of their lactation periods with an intermediate interval during which the defect was not present in the milk. A few cows which produced the defect during the second lactation period of this study had not produced it during the initial lactation period. Several cows produced the defect during the initial lactation period but not during the succeeding one, even though some of them had been persistent producers of rancid milk. A number of cows produced the defect during successive lactation periods.

In general the rancid flavor and odor was most pronounced in milk from the persistent producers of the defect.

M31. Milk as a Frozen Food (A Preliminary Report on Technical Aspects). F. J. DOAN AND J. G. LEEDER, *Pennsylvania Agricultural Experiment Station, State College, Pa.*

Experiments have demonstrated the possibility of manufacturing a frozen concentrated form of milk which may be distributed to the consumer in a manner similar to that used for other types of frozen food.

The milk is pasteurized at 180° F. for 15 minutes, then it is concentrated at a ratio of approximately three to one. After condensing, the hot milk is homogenized at a pressure of at least 3,000 lb. and is then cooled to 40° F. to await initial freezing. Initial freezing is accomplished in either a batch or continuous type of ice cream freezer, the continuous being prefer-

able for several reasons. A minimum amount of air incorporation during freezing is desirable.

When frozen, the milk may be packaged in ice cream containers. The packaged milk is placed in a hardening room for rapid hardening before being stored. The temperature of frozen storage bears a definite relationship to the properties of the protein in the reconstituted product. Temperatures above – 10° F. are unsatisfactory from this standpoint.

The most satisfactory method of reconstitution is to place the frozen block of milk into the proper volume of hot water (180° F.) and to allow it to melt undisturbed. After melting the milk should be stirred to make it homogeneous.

The flavor of reconstituted frozen concentrated milk is little different from fresh fluid, pasteurized, homogenized milk. When pasteurized at the recommended temperature, the flavor is somewhat more "cooked" than ordinary milk but this flavor gradually disappears during storage. The objectionable flavors developed during long holding in storage are "stale" and oxidized. The former does not become objectionable until long after the milk would be used under commercial conditions. The latter flavor may develop unless precautions are taken to eliminate copper contamination.

M32. The Utilization of Skim Milk in Ice Cream Mix. W. S. ARBUCKLE, C. N. SHEPARDSON, AND H. M. WALLING, *Texas Agricultural Experiment Station, College Station, Tex.*

This paper presents information upon the preparation and use of a concentrated skim milk product for the manufacture of ice cream. The method which proved most successful consisted of coagulating skim milk at a temperature of 94 to 96° F. with 10 per cent hydrochloric acid, draining the whey at an acidity of 0.45 to 0.48 per cent, disintegrating the curd by passing it through the screen bottom of a drain rack and then redissolving the curd by use of 5 pounds of sodium bicarbonate per 100 pounds of casein and by heating to 150° F. for 30 minutes. The product was standardized to 16 per cent solids content by the addition of skim milk according to the Pearson Square method or to a Baumé reading of 7.2 to 60° F. The quality and composition control was based upon the use of the acidity tester, a casein test and the hydrometer. The preparation was simplified by completing the entire process by the use of a cheese vat as the major piece of equipment. Disintegrating and heating the curd brought about more rapid dissolving. The heating period reduced the bacterial count of the finished product to fifty thousand or less. The use of skim milk to standardize the finished product to 16 per cent produced a product that was easier to handle and also offered a means of conserving additional non-fat milk solids. An analysis showed that the approximate composition of the finished product was as follows: 16 per cent total solids, 84 per cent water, 13.8 per cent protein, 2 per

cent lactose and 1.5 per cent ash. The cost of manufacture excluding labor was approximately one and one-half cents per pound solids.

The product prepared in this manner was used to supply 10 to 50 per cent of the serum solids content of various ice cream mixes. The data indicate that 37.5 per cent of the serum solids can be supplied by the concentrated skim milk in a 10 per cent fat, 8 per cent serum solids ice cream containing butter as a source of fat. When 40 per cent cream was used as a source of fat, the amount of serum solids that could be furnished by the concentrated skim milk in a 10 per cent fat, 8 per cent serum solids, a 12 per cent fat, 9.6 per cent serum solids and a 12 per cent fat, 11 per cent serum solids mix was 10, 20 and 50 per cent, respectively.

M33. Factors Affecting the Oxygen Content of the Gaseous Phase of Packaged Whole Milk Powder. J. H. HETRICK AND P. H. TRACY, *University of Illinois, Urbana, Ill.*

Particles of spray-dried milk powder contain occluded oxygen which is not removed by the ordinary process of gas packing. Packing milk powder in an atmosphere extremely low in oxygen content, therefore, becomes a problem of control of occluded oxygen as well as one of proper technique in packing. The oxygen entrapped in the particle slowly diffuses into the headspace until equilibrium is reached with respect to oxygen concentration inside and outside the particles. By means of the values for oxygen concentration in the headspace gas immediately after packing and after diffusion was complete, the relative volume of oxygen entrapped per gram of powder was calculated for the milk powders reported in these experiments.

Difference in manufacturing procedure accounted for some differences in the oxygen content of the powder when a standard procedure for gas packing was used.

When the method of spraying was varied, the powder dried using a small orifice and high pressure contained a higher oxygen content per gram than that dried using a larger orifice and lower pressure.

When the method of spraying was fixed and the total solids of the condensed varied from 31–38–45 per cent total solids, the powder made from the condensed having the highest total solids showed the lowest oxygen content per gram.

Powder packed from the drier at a temperature of approximately 120–125° F. showed less oxygen content per gram than powder cooled to 60° F. before packing.

Powder packed immediately after drying at 120–125° F. showed a lower oxygen content per gram than powder aged 18–24 hours before packing.

The addition of 200 parts per million of sodium ascorbate to the condensed before drying resulted in a lower oxygen content per gram of powder over the control with no treatment.

When air was incorporated in the condensed milk before drying by agitation while spraying, an increase in oxygen content per gram of powder was noted over the control in which special effort was used to keep the amount of air incorporated at a minimum.

It would appear from the data that the amount of oxygen entrapped per gram of powder was in part a function of the oxygen dissolved in milk before drying.

The results of a study of some of the factors in technique of gas packing showed that when evacuating to an absolute pressure of 3 mm., no appreciable lowering of oxygen content was noted by holding at this pressure for longer than 10 minutes up to 40 minutes. When powder was packed warm, an increase in oxygen content was observed as the length of time elapsing on soldering was increased. Under the conditions of the experiments reported, it appears that if proper methods are used in preparing the milk for drying, evacuation to an absolute pressure less than 12 mm. was necessary to meet the 3 per cent by volume maximum oxygen requirement as specified by the Quartermaster Corps.

It seemed that in control of oxygen content, the factors in the technique of packing showed more variation than factors in processing and that multiple gas packing was the most effective method for reducing the oxygen content to a minimum.

M34. The Keeping Quality of Commercial Dried Whole Milk Packaged in Air and Nitrogen. G. R. GREENBANK, P. A. WRIGHT, AND E. F. DEYSHER, *Bureau of Dairy Industry, U. S. Department of Agriculture, Washington, D. C.*

A study was made of the effect of inert gas on the keeping quality of commercially manufactured and packed dried whole milk. The general conclusions are based on a study of 1,500 1-pound tins of dried whole milk, and specific data are presented on 350 tins of the spray-dried product. Packaging in inert gas, with approximately 3 to 4 per cent of oxygen in the container, may be conservatively assumed to increase the keeping quality at least 100 per cent, compared with packaging in air. A comparison of accelerated and normal aging was made. Flavor and peroxide values were used as indices of the keeping quality, and are discussed.

M35. Further Observations Dealing with the Behavior of Ascorbic Acid in Evaporated Milk. D. V. JOSEPHSON AND F. J. DOAN, *Pennsylvania Agricultural Experiment Station, State College, Pa.*

A comprehensive survey of the ascorbic acid content of commercial evaporated milks was conducted and reported previously as well as a study of fortification of evaporated milk with this vitamin.

Recent work dealing with fortification at higher levels shows that additions up to 100 mg. per liter (reconstituted) are practical. However, at this level there is some evidence of protein de-stabilization or coagulation during sterilization. This instability characteristic can be controlled by the use of the commonly used stabilizing salts.

Studies with the use of the stabilizing salts show that, on a molar basis, sodium citrate is most effective in preventing coagulation, with disodium phosphate and sodium bicarbonate somewhat less effective.

High temperatures of storage result in greater loss of ascorbic acid than are experienced at lower temperatures.

It has been found that the copper content of the milk is gradually depleted as the storage period progresses.

When infant formulas are prepared from fortified evaporated milk and stored at home refrigerator temperatures, the loss of ascorbic acid is surprisingly low during a 72-hour period. Boiled formulas show somewhat higher losses than unboiled.

M36. A Comparison of the Different Types of Sweetening Agents as Preservatives of Condensed Milk. W. A. HOSKISSON, P. H. TRACY, AND M. J. PRUCHA,* *University of Illinois, Urbana, Ill.*

Six sweetening agents, sucrose, dextrose, Frodex, Sweetose, Confectioners' corn sirup and invert sirup were compared to determine their preserving power in both sweetened condensed skimmilk and sugar-broth solutions.

Six microorganisms, *Escherichia coli, Staphylococcus aureus, Micrococcus pikowskyi,* a heat resistant organism isolated from evaporated milk, *Saccharomyces cerevisiae,* and a yeast isolated from corn sirup, were used as test organisms to determine the preserving properties of the six sweetening agents.

Both the sugar-broth solutions and the sweetened condensed skimmilk samples were stored at room temperature for the entire period of the study.

The sugar-broth and sweetened condensed skimmilk were plated at the beginning and periodically during the study to determine the number of organisms surviving in the samples. The bacterial plates were incubated at 32° C. for three days and the yeast plates at approximately 24° C. for 5 days.

From the sugar-broth experiments it was found that those sweetening agents such as invert sirup, Sweetose and the dextrose-sucrose combination which are high in monosaccharide content were more effective preserving agents than those low in monosaccharide contents such as Frodex, Confectioners' corn sirup or a disaccharide such as sucrose.

* Emeritus.

The preserving action of the sugars in the broth solutions varied with the organism concerned. The yeast isolated from corn sirup was not inactivated in a total sugar-water content of 68 per cent when using sucrose, Frodex or Confectioners' corn sirup, while with the dextrose-sucrose combination 66 per cent sugar-water solution was sufficient to stop its growth. The growth of the yeast was stopped by a 62 per cent solution of invert sirup. The bacteria were generally inactivated at a lesser concentration of the sweetening agents than this yeast. *Saccharomyces cerevisiae* was inactivated by all the sweetening agents in a 60 per cent sugar-broth solution.

The preserving action of the six sweetening agents was studied in sweetened condensed skimmilk containing 42 per cent sugar, 50 per cent of which was sucrose and 50 per cent supplied by one of the other sweetening agents. In the sweetened condensed skimmilk, as in the sugar-broth solutions, those sweetening agents high in monosaccharide content were, in general, better preserving agents than those low in monosaccharide content or disaccharide such as sucrose.

In using the Frodex or Confectioners' corn sirup, it was found that these products had a tendency to cause thickening of the milk if used in quantities as high as 50 per cent of the sugar needed in the condensed milk. It is recommended that the replacement be limited to 25 to 33.33 per cent.

In using invert sirup in sweetened condensed skimmilk, it was found that this product, though excellent as a preserving agent, had a tendency to cause a brown color to develop in the product as it came from the vacuum pan.

In general, sweetening agents high in monosaccharide content, such as invert sirup, Sweetose, and Cerelose, are more efficient preserving agents than those low in monosaccharide content such as Frodex or Confectioners' corn sirup or a disaccharide such as sucrose.

As the concentration of the sweetening agent is increased its preserving power is also increased.

Sweetose is a more efficient preserving agent than either Frodex or Confectioners' corn sirup. Its greater preserving power is evidently due to its higher total sugar and monosaccharide content.

The preserving action of any of the sweetening agents used varies with the organism concerned.

Sweetened condensed milk containing 28 per cent milk solids and 42 per cent sugar, 50 per cent of which is sucrose and 50 per cent of either invert sirup, Sweetose or Cerelose compared to sweetened condensed milk made with 100 per cent sucrose, the former products can be safely stored at room temperature without danger of spoilage by most bacteria or yeast.

Until more is known about the nature and structure of cellplasma membranes and mechanisms by which substances in solution pass through them, it is not possible to state how sweetening agents exert a preserving action on microorganisms.

M37. Iron Content of Evaporated Milk as Related to Greenish-Black Discoloration in Mixtures of Coffee and Evaporated Milk. W. C. COLE AND N. P. TARASSUK, *University of California, Davis, Calif.*

Evaporated milk is often added to coffee as a means of modifying the color and flavor. Under certain conditions a dark-greenish or greenish-black discoloration occurs as soon as the milk is added. Although this phenomenon is fairly common, apparently neither the evaporated-milk industry nor dairy research workers have seriously studied the problem.

Observations with common commercial brands of evaporated milk revealed that this discoloration did not appear when milk from freshly opened cans was added to coffee, but that it sometimes developed when milk was stored in the opened can. The discoloration occurred more often if only a little milk was left in the can. Once it had appeared, it became more intense as the time of holding was prolonged.

The iron content of evaporated milk has been shown to increase rapidly after cans of milk are opened, especially if they are only a fourth or less full. This iron reacts with the tannin or tannin-like substances in coffee to produce the color change. Phosphates and citrates added to evaporated milk may modify the results, but if used within the limits of commercial practice will not significantly influence the tendency toward this discoloration. The reaction of the coffee-and-milk mixture likewise influences the results, since the extent of discoloration as well as the color itself depend upon the pH of the system.

Evaporated milk that has been stored in glass or porcelain after the can is opened will not cause the greenish-black discoloration when added to coffee. If the milk must be held more than 4 or 5 days after opening, it may well be poured into a suitable container.

M38. Can we Hold Our Wartime Marketing Gains in Postwar Adjustments? C. G. MCBRIDE, *Ohio State University, Columbus, Ohio.*

Wartime savings in milk marketing have been in reduction of use of trucks, tires, and gasoline in country assembling and city distribution, the considerable saving of man power due to every-other-day delivery and some reduction in number of products and packages carried. These savings are shown by research in many states on country hauling and New Jersey, New York, and Ohio on city distribution.

Sherman, of the Ohio Agricultural Experiment Station, estimates a possible saving of 20 per cent in country hauling. Not all of this has yet been made. Spencer, of Cornell University, has shown that costs of distribution have been lowered in cities in New York and New Jersey by reduction in number of deliveries. McBride and Keith in Ohio found reduction in mileage as high as 40 per cent and in drivers employed as high as 21 per cent.

Whether these marketing gains can be held depends upon several factors, including the attitudes of producers, dealers, labor, and the consumer. Ohio research indicates a high degree of consumer acceptance and cooperation in the matter of fewer deliveries and a narrower range of products. It was evident from the comments of 1,628 housewives interviewed that by many it was considered a patriotic duty to take such minor inconveniences as a part of wartime sacrifice. They were also favorably impressed by the fact that prices of dairy products had not gone up as fast as those of many other foods.

If wartime gains are held in the postwar period it will be because of sound economic solutions of the following problems:

1. Will farmers be willing to continue with milk trucking as adjusted under the Office of Defense Transportation?
2. Will pressure be brought by labor unions to increase the number of jobs in milk delivery resulting in return to daily delivery and lighter loads?
3. Will dealers in a fierce competitive struggle again multiply the services and variety of products offered the housewife and thereby increase again the costs of distribution?
4. Will housewives continue their favorable attitude and be willing to hold the gains made or will they ask for a return of the old system even at greater cost.

It is difficult to get the answers to these questions in advance. A study just completed in Coshocton, Ohio, in which 587 housewives were interviewed, throws some light on present thinking on two points. They were asked if they would be satisfied with one cream of 30 per cent butterfat after the war. Only 187 of the 587 had bought cream the week of the survey. Of these, 157 said yes and 30 said no. The response with respect to every-other-day delivery was more conclusive. Four hundred and two took all or part of their milk by home delivery. Of these 327 expressed a willingness to continue on every-other-day delivery and 53 said they were not willing, and 22 did not commit themselves.

In the final adjustment much will depend upon the bargaining strength of the producers, dealers, and labor. If no one of these three groups have disproportionate power the chances are good that many of the marketing gains made under the stress of wartime regulation may be held. The extent to which the government will remain in the picture will depend upon how well the industry through cooperative efforts succeeds in holding the gains.

THE TRAINING AND EMPLOYMENT OF MILK SANITARIANS: A COMMITTEE REPORT*

H. F. JUDKINS, *Chairman*, F. H. HERZER, L. H. BURGWALD, P. H. TRACY, C. E. WYLIE, AND C. L. ROADHOUSE

American Dairy Science Association

DEFINITION OF "MILK SANITARIAN"

After spending considerable time in the study of the duties of this committee, it occurred to the chairman that "milk sanitarian" should be defined. He therefore wrote to a number of milk control officials asking them to define "milk sanitarian." Several replies were received.

President C. A. Abele, of the International Association of Milk Sanitarians, has paraphrased Article II of their constitution to define a milk sanitarian as follows: "A milk sanitarian is one who is interested in the development of uniform and proper supervision and inspection of dairy farms, milk and milk products establishments, and milk and milk products; in the improvement in quality of dairy products and the technological development of dairy equipment and supplies; and in the dissemination of useful information regarding dairy sanitation, technology, inspection and administration." This definition is perhaps a little long, although quite fully descriptive.

The following definition from Mr. W. D. Tiedman, of the New York State Department of Health, is brief and yet very much to the point: "A milk sanitarian is a person making a profession of the application of sanitary and health measures to the production, processing and distribution of milk and milk products for the public benefit."

Mr. A. W. Fuchs, of the U. S. Public Health Service, also gives us a concise definition: "A milk sanitarian is a person who is qualified by technical training and experience to supervise the production, processing and distribution of an adequate supply of clean, safe, palatable milk and milk products in the interest of public health."

It is certainly gratifying to note in Mr. Fuchs' definition the statement which should probably be ur lerlined several times, "in the interest of public health." Milk control agencies and officials should always be sure every regulation issued is directly related to public health. Sometimes they are related only to the economics of business operation.

DUTIES, GENERAL QUALIFICATIONS, EDUCATION AND TRAINING

A letter was written to a considerable number of milk sanitarians and

* Reprints of this report may be obtained by writing to R. B. Stoltz, Secretary-Treasurer of the American Dairy Science Association, Columbus, Ohio, previous to November 1, 1944.

heads of dairy departments to get their conception as to the duties, general qualifications, education and training of a milk sanitarian. The replies from these people are summarized as follows:

Duties

1. Inspect dairy farms, receiving stations and processing plants.
2. Supervise design of plants and construction and remodelling of farm dairy buildings.
3. Approve design and test the operation of equipment.
4. Enforce health regulations, and administer licensing system.
5. Prevent spread of disease.
6. Check operations of water and sewage plants and the safety of water supplies.
7. Judge dairy products quality.
8. Inspect health of cows.
9. Make special investigations such as suspected milk-borne outbreaks.
10. Make chemical and bacteriological examinations.
11. Represent health department's case in court.
12. Recognize infectious disease hazards among employees.
13. Inspect dairy vehicles in city.
14. Determine temperature of milk products.
15. Collect samples.
16. Prepare and keep accurate reports.
17. Answer complaints and inquiries.
18. Discuss policies with Public Health Engineer.
19. Help train new inspectors.
20. Increase consumption of dairy products by building confidence in them.
21. Keep up-to-date by:
    (a) Joining organizations that will increase knowledge.
    (b) Attending short courses of instruction.
    (c) Reading technical and trade publications.
    (d) Trying out new ideas that seem practical.
22. Assist producers and operators in solving their sanitation problems.
23. Promotion of adoption of a satisfactory ordinance or amendments thereto.

General Qualifications

A milk sanitarian must have "common sense," sound judgment and the makings of an administrator. He should be able and willing to teach others. He must be diplomatic, alert and practical. He must have a good personality, be able to sell his service and be interested in people. He must be able to gain the confidence of producer, distributor, and consumer, always of unquestioned integrity and never showing partiality. He must be in

good health, with energy and enthusiasm for his work. A keen interest in public health is an important qualification.

Education

It is the opinion of the committee that the educational experiences of the student training for employment as a milk sanitarian should be somewhat broader than those provided by the usual dairy curriculum. Courses should be selected to provide a working knowledge in the following subjects:

Feeding, breeding and management of dairy cattle;

Veterinary science as related to the anatomy and diseases of dairy cattle and the relation of these diseases to a safe milk supply and the economies of production;

Sanitary engineering—sanitary supervision of ground water supplies; water filtration and treatment; chlorination equipment and its use; domestic and creamery waste disposal; air conditioning; humidity control; air filtration; sanitary plumbing and drainage; vermin, rodent and fly control;

Dairy products processing including sanitary quality of all ingredients used other than dairy products;

Relation of milk to the public health emphasizing modes of infection, carriers, protective measures, medical examinations and procedures, epidemiology, diseases of man transmitted through milk;

Food chemistry with necessary prerequisites;

Dairy and pathogenic bacteriology with necessary prerequisites;

Dairy engineering emphasizing refrigeration, heat transfers, temperature control, electric appliances and control, operating methods and maintenance of dairy machinery, sanitary design and construction of dairy equipment and dairy buildings, plan reading;

Mathematics, physics and accounting;

Federal, State and Municipal law enforcement;

Costs and methods of production, transportation, processing and distributing milk and its products;

Laboratory control and analysis of milk and milk products;

Course should include six months to a year of "intern training" with selected health departments or leading processors of milk or milk products engaged in progressive quality improvement program;

English, including public speaking;

A course dealing with the appraisal of the U.S.P.H.S. Standard Ordinance and other ordinances to include the technique (with practice) of making farm and plant inspections;

Business administration.

One health officer states in effect that large state and city health departments can employ specialists, and those with the best personalities and who

develop the best administrative ability are the ones likely to rise to the top positions. Thus it is pointed out that sanitary engineers with some dairy training may be expected to make the best plant equipment and plant process specialists. Veterinarians should make the best farm inspectors. Laboratory testing can be done by dairy bacteriologists and chemists.

While a four-year college course might fit one to take up this specialized work, graduates in dairying, veterinary science and engineering, as courses are now offered, will find it to their advantage to take graduate work which will the better fit them for the complete duties of the milk sanitarian which in the majority of cities in the country they may be called upon to perform. The extra training will also stand out in good stead in the large health departments.

Training and Experience for Key Positions

The selection or advancement of men to key positions should be largely dependent upon experience in the production and handling of milk, the processing of milk and milk products, and in milk sanitation work, together with a demonstrated executive ability.

One Bureau Chief puts it this way: "In my opinion the duties of milk sanitarians should become progressively more of an administrative nature as they gain experience. Beginners should be assigned the simpler tasks such as sample collecting. As they gain experience, they should be assigned to dairy farm and pasteurizing plant inspection, then they may be called on to assist in the investigation of milk supplies under suspicion as responsible for milk-borne outbreaks and to participate in educational programs such as training new inspectors and presenting discussions to the general public. Finally they may be given the full responsibility for the administration of a program in milk sanitation for a municipality, district or state. This would include the making of decisions as to where to place the effort, the assignment of work to subordinates and the establishment of procedures."

DOES THE COURSE OF STUDY FOLLOWED BY DAIRY MAJORS IN OUR UNIVERSITIES AND COLLEGES ADEQUATELY EDUCATE THE STUDENT TO BECOME A MILK SANITARIAN?

Professor Ely, of the University of Kentucky, in the Journal of Milk Technology for May 1938, in summarizing a survey entitled "What the Colleges Are Doing in the Training of Milk Sanitarians," reported an estimated number of 140 four-year graduates in dairying, located in 37 states, were engaged in milk-inspection work. Nevertheless, if we assume that the aforementioned statement on educational requirements represents a fair composite picture of the courses that should be taken by a man planning to become a milk sanitarian, then we would have to conclude that one could not hope to take all of the courses mentioned in four years of undergraduate

work. It seems evident that a special undergraduate curriculum to educate a person to become a milk sanitarian is not warranted by the opportunity that he is likely to have in this profession. The best that can be done is to encourage the dairy major, who thinks he might like to be a milk sanitarian, to elect a course or two in sanitary engineering, some work in public health, some work in veterinary science as related to the anatomy and diseases of dairy cattle and the relation of those diseases to a safe milk supply, a course in dairy engineering which emphasizes the design and construction of farm dairy buildings and processing plants, plan reading, and the sanitary design and construction of dairy equipment.

When one is certain that he is going to make his life work that of a milk sanitarian, he will do well to take graduate work since he will find it impossible to take all of the work that would be of direct benefit to him in a four-year dairy course.

OPPORTUNITIES FOR THE DAIRY GRADUATE AS A MILK SANITARIAN

In the Army. On December 22, 1943, Major C. J. Babcock, a member of this committee, and your chairman had a conference with General R. A. Kelser, head of the Veterinary Corps. As a result of this conference the following statement has been prepared:

The Medical Department of the Army is directed by The Surgeon General, Major General Norman T. Kirk. There are ten Service Commands in the United States and Alaska. The Medical Department services in these respective Service Commands are under the jurisdiction of a surgeon at Service Command Headquarters. Included in the various Medical Department installations and facilities in each of the ten Service Commands is a laboratory which, in addition to other functions, routinely examines food specimens which are sent to the laboratory by Medical Department officers on duty in the geographical area of the Service Command. These laboratories are well equipped and are conducted by officers of the Medical Department, including Medical Corps, Veterinary Corps and Sanitary Corps. In addition to the Service Command laboratories many of the larger posts, camps and stations have laboratories which are operated in connection with the post, camp or station hospital. Many of these station laboratories are equipped to do bateriological and chemical control work in connection with milk and dairy products.

The Service Command laboratories are fully capable of meeting all Medical Department requirements not handled by post laboratories. There has been an opportunity for some men trained in dairying, particularly those having had considerable bacteriology and chemistry and laboratory experience, to be placed in both the Service Command and station laboratories, and some dairy graduates are so engaged. Some of these men hold commissions in the Sanitary Corps and some are on duty as enlisted technicians.

The Veterinary Corps, of which General Kelser is in charge, is a branch of the Medical Department operating under the Surgeon General. The functions of the Veterinary Corps fall in two distinct categories—those having to do with the health of military animals, and those pertaining to the inspection of meats, meat-food and dairy products.

The Veterinary Corps is responsible for the evacuation and medical and surgical care of sick and wounded animals; the management and control of veterinary military hospitals and all other veterinary units; investigation of the hygiene and the sanitary condition of the animals of the Army; advising as to methods of animal management; instructing military personnel in animal sanitation and management; and the inspection of forage.

In connection with its food inspection functions, the Veterinary Corps is charged with the inspection of all food products of animal origin, which of course includes milk and its products. Thus, it will be seen that dairy products inspection is not the major part of the job of the Veterinary Corps. Except for a few dairy specialists, there is no such thing as a full time dairy inspector in the Army nor would it appear that there could be, since the bulk of the work that has to be done by the Veterinary Corps is foreign to the experience and training of the dairy student or milk inspector.

Men holding a Reserve Officer's commission as a result of R.O.T.C. training in college when entering the Army are generally assigned to the branch of service for which their R.O.T.C. training qualifies them. While occasionally such a person with dairy training might be transferred for special milk work, this is rarely done.

When the dairy graduate who does not hold a commission is inducted into the Army, he reports along with everyone else inducted into the Army, to an induction center. He then proceeds to a reception center and from there to a replacement training center. Such of these men who go to a Medical Department Replacement Training Center are given a course of basic military training supplemented with special studies to fit them for Medical Department duties. At these medical training centers, the dairy graduate, for example, might, after his training, have an opportunity for assignment to a Service Command or post laboratory, or for work as an assistant to a veterinary officer who would be in charge of food inspection work, including milk and its products. Whether or not any of these men would subsequently have an opportunity of obtaining a commission would depend upon military requirements and vacancies, particular qualification, demonstrated proficiency, etc.

The Reception Centers often have more men with training or experience in a particular field, dairying for example, than there are places in the Army for men with the particular type of training. This, in part at least, explains why the men are not always placed where they feel they can make best use of their experience.

General Kelser explained that in the inspection of milk supplies for the Army it is not the purpose to take over the functions of local health officers or milk control officials. The purpose is to work with local authorities and, where satisfactory conditions are found, the Army's inspection of milk plants is then limited to periodic check inspections to insure that good conditions continue, and to bacteriological, chemical, and other laboratory tests of the delivered milk. In some areas local health authorities for various reasons are unable to do as good a job on their own account as they should, or to cooperate satisfactorily. Where this happens, the Army obviously must give more attention to milk control measures in the area than would otherwise be the case. It is definitely the policy of the Veterinary Corps in their milk inspection work to regularly analyze samples of the product in the post command laboratories and where the results indicate the product is satisfactory, particularly such things as the bacterial count and the coliform count, and the phosphatase test, very little time is spent by a veterinarian or one of his assistants in inspecting the farms where this milk is produced or the plant where it is processed. That undoubtedly explains to some degree why some dairy plant operators feel that veterinarians or their assistants who visit their plants spend little time in them and seem to know so little about product processing. While, as General Kelser explained, it is, of course, true that many of the veterinarians have not had extensive experience in plant processing, they have had basic training in food handling and control. Furthermore, a refresher course is given to groups of twenty to twenty-five veterinary officers each month at the Chicago Quartermaster Depot in Chicago. In these courses some time is devoted to milk and dairy products.

The above should explain why the number of jobs for dairy graduates doing milk and dairy products inspection work in the Army is limited. The inspector apparently has to be an overall purpose animal food inspector; and certainly with the basic training that veterinarians get, it is comparatively easy to train them to do what dairy products inspection is necessary, whereas it would be entirely impractical to train a dairy graduate in what a veterinarian knows about the inspection of meat, eggs, poultry and the care and treament of animals, etc. The Veterinary Corps will do well in designating men for milk inspection work to try to select men endowed with better than the average amount of practical common sense. Several milk sanitarian associations have voiced their sentiments that qualified milk sanitarians should be used in the armed services whether or not they are veterinarians, but the answer has always been that it is "contrary to policy." Thus a committee of the New York State Association of Milk Sanitarians concludes in their 1943 report, "The Committee now feels that the only approach to the problem is a long-range program of education. The proper recognition of the qualified milk sanitarian should be established in civilian capacity as well as in the armed forces."

In the U. S. Public Health Service. The following statement is copied from the Journal of Milk Technology, November–December, 1943:

Dairy Graduates in U.S.P.H.S.

"In Mr. Sydney Shepard's article on the educational background of milk sanitarians in the July–August issue, the following statement appears on page 235: 'Today, only sanitary engineers may hold commissions as milk sanitarians with the U.S.P.H.S.' I wish to point out that this was formerly the case but is no longer true. During 1943 a number of dairy graduates, veterinarians, bacteriologists, etc., have been commissioned for active duty on milk and food sanitation in the Public Health Service Reserve, and additional appointments are being processed. Other milk sanitarians on duty under Civil Service may be eligible for commission but prefer not to apply. Of the 30 milk and food sanitarians appointed to date for field duty, 5 are engineers (all commissioned), 4 are veterinarians (2 commissioned), 7 are bacteriologists, biologists, etc. (2 commissioned), and 14 are dairy graduates (10 commissioned). It is evident, therefore, that dairy graduates constitute the largest single professional group of Public Health Service milk sanitarians, both in total number and in commissioned personnel, and that engineers comprise a small minority.

"The question of the proper qualifications for milk sanitarians is indeed a complex problem and one which must be treated with diplomacy and mature judgment so as to avoid apparent favoritism toward one group or another. Persons with several different types of education can and are rendering valuable service in milk sanitation work. The present war conditions demand the best efforts of milk sanitarians as individuals, the proper utilization of the skills of all of them, and above all the greatest possible unity of effort.

"Very truly yours,
"A. W. Fuchs
Sanitary Engineer Director
in Charge, Milk & Food Unit"

In City and State Health Departments. The number of positions carrying considerable responsibility and paying what might be considered an adequate salary that are available in city and state health departments is, of course, limited. Frequently dairy graduates engage in this work and then drift into other fields of work. Professor Ely, in the report above referred to, has found that this was the trend in 20 states. The matter of political pressure on workers and the politics entering into the matter of salary increases were given as the principal reasons why dairy graduates shift from health department work to other fields.

In Private Industry. More and more, private industry is carrying on quality control work on milk and milk products, and naturally this is a more attractive field to the dairy graduate from the matter of salary and opportunities for advancement. The fact that up to the time the war started the commercial dairy industry had been able to absorb practically all of the good four-year dairy manufactures graduates to engage in various activities in the business is undoubtedly one of the principal reasons why more of these graduates have not entered or continued to work for public milk quality control agencies.

SUMMARY

1. Three definitions of a milk sanitarian are presented.

2. Based on correspondence with several milk sanitarians and the heads of several dairy departments, the duties, general qualifications and the type of education and training for a milk sanitarian have been listed.

3. It is concluded that courses in dairying, as now offered, do not completely educate a student in all of the qualifications of a milk sanitarian. It is felt that a special course to do this is not justified. A student who thinks he might like to engage in milk sanitation work should be encouraged to elect certain courses, along with his dairy work, and if he expects to go far in the milk sanitation field, he will do well to do graduate work so that he can get more of the courses that will be helpful to him.

4. Due to Army policy, there appears to be little or no opportunity for the dairy graduate to be commissioned to do milk sanitation work in the Army. The committee urges that the American Dairy Science Association use its best efforts to improve this situation.*

5. It is apparent that opportunities for dairy graduates to do milk sanitation work do exist in the United States Public Health Service.

6. There are opportunities for dairy graduates in milk sanitation work in City and State Health Departments but the future which the positions offer and the rate of pay are such as to make the positions rather unattractive.

7. There is more and more opportunity for the dairy graduate to do milk sanitation work in private industry. These positions are attractive because of the wide possibilities of advancement in the industry.

* See resolution passed by The American Dairy Science Association at the Annual Business Meeting, June 22, 1942.

THE THIRTY-NINTH ANNUAL MEETING OF THE AMERICAN DAIRY SCIENCE ASSOCIATION

R. B. STOLTZ, *Secretary-Treasurer*

The American Dairy Science Association assembled in Campbell Hall on The Ohio State University campus at Columbus, Ohio, on Tuesday, June 20, 1944, at 10 A.M.

Dr. Arthur C. Dahlberg, President of the American Dairy Science Association, called the meeting to order, and presented the following officers: Vice-President Arthur C. Ragsdale, Directors P. H. Tracy, C. L. Blackman, R. B. Becker, W. E. Petersen, G. M. Trout, H. P. Davis, Editor T. S. Sutton, and Secretary-Treasurer R. B. Stoltz.

Dr. Howard L. Bevis, President of The Ohio State University, was then introduced and delivered an address of welcome.

President A. C. Dahlberg gave the following response:

President's Address

THE APPLICATION OF SCIENCE TO THE DAIRY INDUSTRY

A. C. DAHLBERG

Last year our president, H. P. Davis of Nebraska, gave us a very interesting and scholarly address on the subject of dairy science. It seemed to me to be appropriate to follow his address by one dealing more specifically with the application of science to the development of the dairy industry.

Progress in dairy science and in the dairy industry in this country has been very rapid, yet it might also be considered as very slow, depending upon the point of view. It has been very rapid in that the present modern commercial dairy industry has developed principally within the last fifty years. It is often said that during this period more progress has probably been made than in all previous history. Milk plants, cheese factories, ice cream plants, and condensed and dry milk factories were minor factors in marketing and processing milk and its products over fifty years ago. At that earlier time, within the memory of our older members, the feeding, breeding and management of dairy cattle was primitive indeed when considered in comparison with scientific feeding, herd testing, constructive breeding, and artificial insemination of today. On the other hand, progress has been very slow indeed when one views the situation from the viewpoint of the progress in the establishment of new dairy practices and products of the past half century.

We have been such enthusiastic worshippers of scientific research that there is a tendency to overemphasize the true significance of each individual

discovery and to exaggerate its effect upon the dairy industry. My purpose is to point out that few individual discoveries have materially affected the dairy industry but the total of these little additions to our knowledge has produced continual slow progress. Let us consider the facts, that our prospectus may be more accurate.

Dairy Cattle Breeding and Milk Production

Textbooks written about 1850 to 1890 describe all the present breeds of dairy cattle now important in the United States. Photographs of Ayrshire, Jersey, Guernsey, Holstein, and other cattle show types that can be easily recognized today. Many of the illustrations could be used in modern books but few of these cows would place in present-day cattle shows. Advances in genetics have not developed a new or superior breed of dairy cattle.

The purpose of the dairy cow is the production of large quantities of milk, the only substance produced by nature for exclusive use as a food, and it is surprising how much milk was produced by some of the dairy cows of the preceding century. For example, Dr. E. Lewis Sturtevant, before he became the first Director of the New York Agricultural Experiment Station at Geneva in 1882, was a noted breeder of Ayrshire cattle. A writer of that time wrote about Mr. Sturtevant's herd that "his herd of 65 Ayrshires in June, 1864, produced an average of 33 pounds of milk per cow." This writer also stated that "Good Jersey cows usually give forty pounds of milk per day when fresh and ten pounds of butter per week." These are good records today. Doctor Sturtevant wrote a book, entitled "The Dairy Cow." She was the Ayrshire. In this book are the following statements: "In 1873 General S. D. Hungerford of Adams, Jefferson County, New York, exhibited at the New York Fair at Albany an Ayrshire cow known as 'Old Creamer' whose yield of milk has never to our knowledge been surpassed. Old Creamer is nine years old and weighs 1080 pounds. In three days she yielded the enormous quantity of 302 pounds of milk. . . . She gave 2820 pounds in the month of June; an average of over 94 pounds per day, 2483 pounds in the month of July, an average of over 80 pounds per day." About a decade ago I checked production of the Ayrshire herds of our colleges and I did not locate one cow that equalled or exceeded this production.

Not all cows were good cows then and not all of the best farmers had good dairy cows. There were poor herds then as there are now. To illustrate, George Washington, a master farmer of real ability, wrote to his farm manager a note in which he stated, "It is hoped and will be expected, that more effectual measures will be pursued to make butter for another year; for it is almost beyond the belief, that from 101 cows actually reported on a late innumeration of the cattle, that I am obliged to buy butter for the use of my own family."

The discovery of Mendel's law of inheritance has added to our knowledge but has not materially advanced the breeding and production of dairy

cattle. The present development in proved sires, herd testing, and artificial breeding should greatly increase milk production for the first time in generations. The greatest advances ever made in the improvement of dairy cattle are just commencing. Although some excellent research has been basic to this probability and must continue, the major effort to develop the program now must be in teaching and extension.

Dairy Products

Milk, cheese and butter are products mentioned in the earliest of historic writings. Dry and concentrated milks and ice cream were produced prior to the advance of modern commercial dairying. The question may be asked as to the dairy products that are new in the last half century. These products, such as lactose, casein plastics and cloth, dried whey and others, represent a very minor portion of the dairy industry. No entirely new product of great importance at the present time has been invented.

It would be incorrect even to imply that scientific research has not greatly assisted in the modern, great development of the dairy industry. Present-day dairying is dependent upon the accumulation of scientific knowledge and application to dairy practice.

Perhaps the first modern advancement in scientific dairying that should be mentioned is a practical test to determine the fat content of milk. This test to us is that developed by Dr. S. M. Babcock, but in some other countries it is the test of Dr. N. Gerber. The contribution of Dr. Babcock in perfecting the test consisted chiefly in standardizing the strength of the acid and in developing a pipette to deliver the correct weight of milk for the test bottle employed. He used a centrifuge and a special test bottle, but these were not new. There were several tests then on the market that were more or less successful. Based upon present interpretation of patent laws I doubt that Dr. Babcock's research of his test represented a clear-cut patentable invention. Nevertheless, I believe that this test is absolutely fundamental as the basis for modern commercial dairying, both production and manufacturing, and represents one of the great research developments of modern dairying.

Another development of recent origin that has made modern dairying possible, especially the fluid milk industry, is pasteurization. It is true that Dr. Louis Pasteur applied his process to wine fermentations in 1864 but he did not apply it to milk, and its application to milk and milk products by others is of more recent origin. In this connection it is interesting that some books whose publication precedes the pasteurization of milk actually mention that scalding milk improved its keeping quality. Without pasteurization the maintenance of safe dairy products of good quality would not be possible as they need to be handled on a large-scale basis.

The butter industry became a major branch of commercial dairying after the invention of the cream separator made it possible to eliminate gravity

skimming. The chief contribution of Carl Gustaf DeLaval that made the centrifugal separator possible was the devising of a procedure to make the process a continuous one. DeLaval was not the first to remove the cream from milk by centrifugal means. The continuous cream separator made it possible to have a large factory system of manufacturing butter and is, therefore, one of the great developments of the dairy industry. It is of recent origin.

Thus, the three great developments of the dairy industry of modern times aided recognized products and processes rather than created new ones. There are several products recently developed by research that are very important factors in the dairy industry. Process cheese by its uniformity, keeping quality, and packaging has created new markets for cheese. Ice cream, concentrated milk, and dry milk are largely the result of a mass of scientific research and practical developments which has made them as they are today. Although Gail Borden is said to have invented condensed milk, he actually made it commercially feasible through the exclusion of air during concentration and the use of milk of good quality. Most of our major dairy products have been developed through much research and development and not through revolutionary scientific research.

Progress on basic foods is seldom rapid. One of my purposes in this discussion is to emphasize that progress must be slow in the advancement of the production and processing of an agricultural good like milk and its products. The research program must be extensive, yielding information on many aspects of the subject. Some of the new facts explain why processes must be as they are, others are informational only, while more limited facts are utilized to advance some phase of our industry. Each contribution in itself may seem small, yet each to a greater or a lesser degree adds to dairy knowledge to improve both science and industry. This should encourage us all to do our bit to the best of our ability with full knowledge that it rarely happens that a discovery is made that greatly affects the industry but that the mass of knowledge means progress. Actually more effort is often required to adapt and to promote the newer knowledge into the dairy industry than was required to discover it.

In the fields of chemical and physical research the results often produce revolutionary products and processes that affect our whole nation. Automobiles, radios and plastics are examples. Such research stimulates our imagination and brings new industries and products into our daily lives, but such research never has revolutionized the dairy industry. Such new industrial products then require manufacture and merchandising, but in the dairy industry there is need for an immense effort in teaching and extension to promote the newer knowledge as it applies to our older products. Such is the case for the discoveries of the excellent nutritive properties of dairy products for they do not create new products but require education of the people to use more dairy products for their improved nutrition.

Then too, the margin of profit in the dairy industry is too small to permit most extensive research and development of entirely new products. The business from the farm to the consumer is so fixed in routine, regulations and margins of profit that it is more difficult to introduce radically different products. Some dairy companies are sufficiently large to maintain excellent research laboratories. Such research must be confined largely to projects which show promise of immediate practical application for it is not apt to be true in dairy research that studies of pure science may yield greatest dividends as so often occurs in chemical and physical research laboratories. Advances in pure science sometimes advance dairy science which in turn may improve our dairy practices.

Dairy research for both dairy farmers and manufacturers of dairy products must be conducted chiefly by public research agencies supported by private and public funds. Private funds will need to be given more and more from current earnings rather than through inheritance as has been done in the past. Some excellent long-time dairy-cattle projects could be endowed in this manner. It would be most unfortunate for the public if the advances in dairy products were limited largely to the research of the larger dairy companies, important as their research may be. There is need for public research in food processing of the most important foods in the United States when viewed from both nutritional and financial standards, namely, milk and its products. It is only through such research that the entire industry may advance to the fullest extent. Our legislatures and agricultural leaders often overlook this fact. We have tended to take this advancement for granted because it has occurred in the past, or we have said that the dairy industry could serve itself by applying fundamental science to its problems. This application is often much more difficult to solve than the problem in fundamental science.

The American Dairy Science Association

As President of our Association it is proper in conclusion to comment briefly upon some aspects of its work and development. The Association has served well in many respects in aiding dairy science and the dairy industry. We have been rather modest in the publicity given to the work of the Association. This is undoubtedly a desirable virtue, yet it has tended to minimize somewhat the Association, particularly in the views of scientists in other professions.

The tremendous amount of effort of the many committees of our Association is scarcely appreciated even by our own membership. The accomplishments of these committees are the reward of its members for their efforts. For example, consider the valuable work of the committee on the testing of dairy cattle for production and of the committee on standardization of technic of the Babcock test. Their recommendations are standard

procedures. Our Association serves as a common meeting ground to present the work of our members. In normal times and in recent years, the annual meeting has been a combination of scientific work and social fellowship that has been most conducive to good work and cordial relationships.

The work of our Association must be centered in the Editor of the Journal and the Secretary-Treasurer. Both tasks require much effort and must be done extremely well by men of training, temperament and ability to do the work. Furthermore, both tasks must be done chiefly for the good of the Association, dairy science, and the dairy industry, for neither office is paid a salary sufficient to attract men of the ability required to do the work. The work of the Editor as shown in the scientific standards of the Journal of Dairy Science is a direct reflection on the character of our membership, which means you and me. It is brought to our attention and to all readers each month as Journals arrive. The work of the Secretary is not so obvious. He must guide our Association under the supervision of the Executive Board. It is no accident that our membership has increased about fourfold in the last fifteen years; that our income from advertising has increased about fivefold in this same time; that the financial reserve of our Association has increased from nothing to an amount equalling a full year's income; and that our membership fee has not changed while the size of our Journal has more than quadrupled. These results are due in part to continual effort on the part of the Secretary for which he is paid for all his services the equivalent of a reasonable rate that would be charged by an advertising firm to secure the advertising alone. Our Association is fortunate indeed to have the services of our present Editor and Secretary. May we give them partial compensation for the splendid services which they render to our Association by our appreciation and loyalty.

Let no one assume that our Association has reached its goal, its maximum development, and from now on we shall coast easily along. We must progress or we shall go backward. I well remember when we were struggling to secure a membership of 400; now we have a larger attendance than that at our annual meetings. After this war there is an opportunity for a greatly increased sale of the Journal of Dairy Science outside the United States. Now our foreign subscriptions are subnormal. Our Journal is a leader in its field, it is improving, and these foreign workers need it more than ever before. After the war there should be a material increase in the membership in our colleges. Men in commercial work have been joining our Association in increased numbers and they are especially welcome. These men are in research, production, and extension. Membership in the American Dairy Science Association of college workers in the research, teaching, or extension in all phases of the dairy industry is almost obligatory to keep abreast of the times. Our college men must be leaders in dairy education. The future of our Association is very promising.

Mr. Games Slayter, Vice-President in charge of research and development for the Owens Corning Fiberglas Corporation, of Newark, Ohio, was then introduced and gave a very stimulating address, bringing out the need for more research in this country if we may expect to compete with other countries.

President Dahlberg then announced the Resolution Committee:

FORDYCE ELY, *Chairman* H. F. JUDKINS
I. R. JONES C. R. GEARHART
H. P. DAVIS

He also announced that the Directors had accepted an invitation to meet at Iowa State College at Ames, Iowa, in 1945.

There were 233 members present. The meeting adjourned at 11:40 A.M.

GENERAL MEETING OF THE AMERICAN DAIRY SCIENCE ASSOCIATION

Columbus, Ohio, June 22, 1944

President Dahlberg called the meeting to order at 3:30 P.M. in Campbell Hall, there being 95 present.

EDITOR'S REPORT

The Editor begs to submit the following brief report to the membership of the Association:

A summary of the Journal contents for the past five years is in the accompanying table. These figures are on a comparative basis and include the contents of twelve issues, July to June inclusive.

It will be noted that, in spite of war conditions, contributions to our Journal have held up remarkably well. The number of original manuscripts published during the past year is exceeded by that of only one previous year, 1941–42. The articles were of somewhat shorter average length, and fewer pages were devoted to review articles resulting in a decrease of 210 printed pages during the past year.

Only one review article was published during the year; another has been received and will appear in the July issue. Several others are reported to be in some stage of preparation.

The number of pages of abstracts has fallen off slightly. This is not a reflection on the effectiveness of our abstracting organization but rather a result of a little finer sifting and a decrease in the quantity of published material of interest to the dairy industry.

Again your Editor wishes to acknowledge the cordial spirit of helpful cooperation of all those who have assisted in the discharge of editorial responsibilities.

SUMMARY OF JOURNAL CONTENTS

	1939–40	1940–41	1941–42	1942–43	1943–44
Number of original articles	94	97	101	89	99
Pages of original articles	826	892	938	788	706
Number of reviews	3	5	3	2	1
Pages of reviews	120	144	80	142	64
Miscellaneous	212	278	106	192	206
Announcements, Proceedings, Circulation, Index, etc.					
Pages of Abstracts	206	304	418	290	226
Total number of pages printed	1454	1618	1542	1412	1202
Classification of Articles					
Manufacturing articles	53	56	59	50	52
Pages occupied by Manufacturing	450	514	548	414	480
Production articles	31	35	36	32	42
Pages occupied by Production	296	216	336	314	325
Manufacturing-Production	10	6	6	7	5
Pages occupied	80	62	54	60	46
Manufacturing reviews	0	5	1	1	1
Pages occupied by Manufacturing reviews	0	144	36	86	64
Production reviews	2	0	2	1	0
Pages occupied by Production reviews	120	0	44	56	0

Upon motion duly seconded the report was accepted.

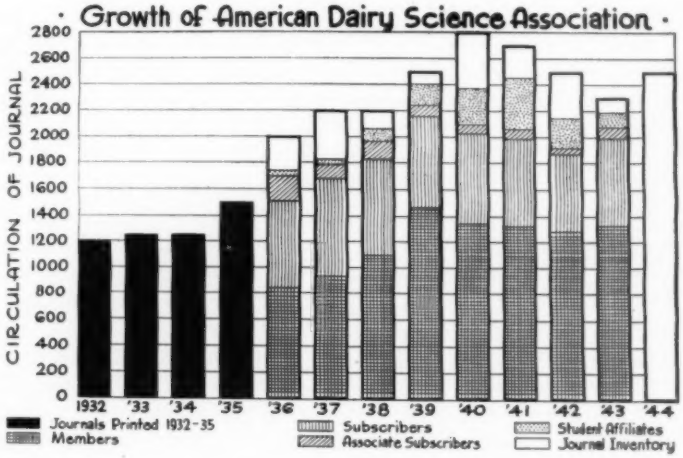
SECRETARY-TREASURER'S REPORT

Membership and Circulation. The circulation of the JOURNAL OF DAIRY SCIENCE for the year 1943 was very satisfactory. We had 1324 members, which is the highest membership we have had, with the exception of the years 1939 and 1940. Without putting on an organized campaign, we received 134 new members, 83 of which paid the $5.00 affiliation fee and 51 of which were former student affiliates.

The domestic subscribers amounted to 463, which is almost 100 more domestic subscribers than the Journal has ever previously had. Our foreign subscribers were 208, which is the lowest we have had in the last seven years. We had 85 associate subscribers, which is the highest since 1938, and 108 student affiliates, which is the lowest we have had since 1938, making a total circulation for 1943 of 2,197. The chart shows the growth of our circulation over the past twelve years. The height of the current column indicates the number of Journals that were printed. We anticipated a decreased circulation in 1943 over 1942, but our membership and domestic subscribers both increased to such an extent that the dropping off of the foreign subscribers and student affiliates was more than overcome. Thus far in 1944 our circulation is ahead of last year's at the same time by more than 100. As of June 17 our membership this year is 1281 while last year at the same date it was 1245. Our domestic subscribers are 467 while last year they were

402. Our foreign subscribers this year are 206, and last year they were 166. Associate subscribers are 78 versus last year's number of 64. Student affiliates this year are 39 and last year 100. The total circulation on June 17, 1944, is 2071 and last year at the same date it was 1977.

Our delinquents this year are less than usual, but we may always expect to lose approximately 10 per cent of our membership annually. Therefore, in order to hold our present circulation, it will always be necessary to be on the alert for new members and subscribers. After the duration our circulation list should be at least 3,000 and in the future our new members should largely come from our student affiliates. Your Directors have taken action



which will permit student affiliates who were in the military service to become members without paying an affiliation fee at the end of the duration.

During 1943 we had 2300 Journals printed, thinking that the circulation would decrease at least 200 under 1942. Instead of this our circulation was higher in 1943 than in 1942; consequently, all the Journals that were printed were sold and it was, therefore, necessary for us to advertise and buy back the 1943 Journals. We were able to purchase 58 volumes for $173.50, 11 of which have been sold, so that our present inventory will take care of the needs for the next few years.

Back Copies. We are now able to supply all the back copies of the Journal because the Board of Directors have reproduced 13 numbers at the cost of $1710.18. We have approximately 40 or more volumes of each year, with the exception of Volume XXII (1939). During 1943 we sold $1133.85 worth of back copies, while in 1944 up to June 1 we have sold $1122.25, which included eight sets of all back Journals.

The following pamphlet "To Readers and Authors of Scientific Papers" was sent to our membership last fall: "The Officers of your Association are anxious to have you read the following editorial written by the Editor. He is attempting to get the authors to write the material in your language and asking you to increase your vocabulary, so that you will understand it. We commend this article for your reading. Signed, A. C. DAHLBERG, President, American Dairy Science Association.

Your Journal. Keeping Abreast with Progress

"The JOURNAL OF DAIRY SCIENCE made its first appearance in May, 1916. At that time the American Dairy Science Association felt the need of a scientific journal devoted to dairying to serve as a place for the publication of the researches of its members. The science of dairying was then in its infancy and those engaged in research and teaching were directly interested in all phases of the subject. Great developments were in the offing, however, and the rapid advances which were soon to follow surpassed even the dreams of those who pioneered in the field. The JOURNAL OF DAIRY SCIENCE takes modest pride in the part it has played in the progress of dairying.

"Dairying is an applied science rooted in the fundamentals of chemistry, physics, biology, etc. As the scope of interest broadened, specialization became a necessity. Today the broad field of dairying includes a wide diversification of interests. This diversification of specialized interests has brought about changes in the JOURNAL OF DAIRY SCIENCE. Today, it would be unusual indeed if every original article in a single issue was of direct interest to every member of the Association. Every volume, however, contains a wealth of material for everyone engaged in the industry. Since the material printed presents new facts and new applications of established facts not previously published, a single article may have inestimable value.

"With the more direct application of the principles of fundamental science to the problems of the industry, the vocabulary and phraseology of the articles appearing in your Journal has changed.

"For example, the researcher, who is making use of his knowledge and skills of chemistry in solving a problem of the industry, will quite naturally use the vocabulary and phraseology of the chemist in reporting his work. Accuracy and precision are essential and at times may be obtained only by the use of scientific terms.

"On the other hand, the use of scientific language may kill the interest of the practical man who could make immediate use of the findings reported. Many scientific researchers claim to have no interest whatever in the practical application of their findings. Yet, were it not for these practical applications, the social system, which supports these fundamental researches, would soon see no need of their continuation and withdraw their support. Simplicity has great virtue, and the presentation of results in understandable terms need not detract from the scientific value of the work.

"The practical man is not without responsibility in this connection. It is his obligation in supporting progress to rapidly become familiar with the language of his profession. Each new development brings new additions to our vocabulary. At first, these new additions may be confusing but many of them are destined to become everyday household terms.

"The policy of the JOURNAL OF DAIRY SCIENCE must be '*constantly forward.*' Real progress can only be measured by the accomplishments of the group as a whole, not by the few leaders who form the 'advance patrol.' Your Journal is dedicated to the purpose of keeping you fully informed concerning the activities of those who through their researches are advancing the science of dairying. You are then in a favorable position to carry out the everyday affairs of the industry with greater dispatch and efficiency. Signed, T. S. SUTTON, Editor."

On the back of the pamphlet is the following notice: "A Library for Each Laboratory. Wouldn't it be a smart move to have all the back volumes of the Journal with the 20-Year Index in every commercial dairy laboratory? Don't you think every milk, ice cream, evaporated milk and powdered milk plant should have a library as much as it should have a receiving vat or compressor?

"You may not have anyone who has time to read now, but this may be the proper time to procure the backbone of your library, which should be the 26 volumes of the JOURNAL OF DAIRY SCIENCE, with the 20-Year Index. The cost is $145.50. If you're paying 90 per cent taxes on excess profits, it makes your library quite a low cost."

During the year a pamphlet entitled "*Opportunities in the Dairy Industry in the Post War Period*" was offered to schools to be furnished to the graduates and undergraduates in the service: "The Officers of the American Dairy Science Association have prepared this pamphlet for the benefit of the boys in the Service who have had some Dairy Science Training. Additional copies may be obtained by writing the office of the Secretary. Signed, A. C. DAHLBERG, President, American Dairy Science Association.

"In keeping with the purposes of the American Dairy Science Association we are interested in encouraging all the boys in the service to continue their college education at their earliest possible opportunity.

"There is going to be a greater demand for trained men than ever before. There has never been an over-supply of trained dairymen, and now there will be an even greater shortage. There are so many things that will need to be done. The dairy industry is still young, and the surface has barely been scratched.

"1. Dairying has developed from a farm dairying practice to a profession.

"2. Each year brings a greater general recognition of the necessity of dairy products in the diet and greater demand for them.

"3. Expansion of the dairy industry is inevitable because of the greater appreciation of the nutritional value of milk and its products.

"4. New processes will be developed which will require the best technical training.

"5. More emphasis will be placed upon efficiency in both manufacturing and production of dairy products.

"6. There is every indication of a great expansion in research both private and tax-supported.

"7. Practices in the production field have taken a technical turn requiring highly trained personnel. Example, artificial insemination.

"8. Many from the technical staffs of our public educational and research institutions have gone into commercial work. Many of these will not return to their old jobs following the war. Replacements must be found among those who finish their training after the war.

"9. In every post-war period the nation has previously encountered, the necessary readjustments 'spot-lighted' dairying on farms and commercially. International adjustments will be important after this war.

"10. Present war experiences have opened a new outlook on the need for advancement in our production and processing methods; especially in preservation, storage, packaging, and new products.

"The American Dairy Science Association believes that the dairy industry will demand far more professionally trained men in the next decade than will be available. Therefore, we urge those who have some training, who like the profession, and who are enthused about its future, to return to college to complete their course or for a refresher course."

Advertising. Our advertising income is still on the increase. In 1942 we sold 143¾ pages, which was higher than any previous year. In 1943 we sold 171 pages. Our advertising for the first half of 1944 is equal to 1943. We are very anxious to again express our gratitude to the companies that use our pages for advertising. Any courtesies shown these advertisers will be much appreciated.

Financial. The income for 1943, amounting to $19,617.26, is the largest of any year during our organization. Our expenditures, amounting to $18,539.61, leave an operating profit of $1,077.65, which more than wipes out the deficit of $1,052.20 made in 1942.

As of December 31, 1943, our net worth was $22,645.56 and we had an investment in Government bonds of $19,690. A complete report of the Certified Public Accountant was sent to each Director and Officer in February of this year.

The Secretary-Treasurer wishes to take this opportunity of expressing his gratitude and thanks to the officers and members for the splendid cooperation that has been received.

Respectfully submitted,

R. B. STOLTZ, *Secretary-Treasurer*

AUDITING COMMITTEE

The President then requested a report of the Auditing Committee, which was given by Mr. L. H. BURGWALD, *Chairman.*

March 27, 1944

To the Members of the American
Dairy Science Association
Gentlemen:

Mr. Walter Burnham, of Columbus, Ohio, Certified Public Accountant, has made an audit and report of the financial condition of the Association.

The Auditing Committee has conferred with Mr. Burnham and is satisfied that he has made a careful examination of all assets and liabilities of the Association and that all the accounts are accurate. The committee is satisfied that the balance sheet and related summary of profit and loss represents the financial condition of the American Dairy Science Association.

Respectfully submitted,

L. H. BURGWALD, IVAN MCKELLIP, H. E. OTTING

Mr. Burgwald moved and Mr. Blackman seconded that the Auditing Committee report be accepted.

Mr. D. M. Seath moved and Mr. W. L. Clevenger seconded that the Secretary-Treasurer's report be approved.

JOURNAL MANAGEMENT COMMITTEE REPORT

Columbus, Ohio
June 19, 1944

Executive Board
American Dairy Science Association
Gentlemen:

This has been a good year for the JOURNAL OF DAIRY SCIENCE from the viewpoint of the Committee on Journal Management.

The President of the Association, the Secretary-Treasurer, and the Editor of the Journal have functioned so efficiently in their respective capacities that but few problems have confronted the Committee on Journal Management during the year.

Among certain items that have received the attention of the Committee was the question of publishing news items in the JOURNAL OF DAIRY SCIENCE. The Executive Board had referred this matter to the Journal Management Committee for consideration, inasmuch as there had been some agitation for such news items in recent years. President Dahlberg, in submitting the problem for the careful thought of the Committee, called to attention the fact that the JOURNAL OF DAIRY SCIENCE once did publish news items and that they were discontinued largely because they were so incomplete and unsatisfactory. When he first became editor of the Journal he appointed a news reporter in every Dairy Department in every State but satisfactory

results did not materialize. He suggested that if the news item feature were adopted a special effort will be needed to make such a service satisfactory to our members.

After careful consideration, the Journal Management Committee was inclined to disfavor this venture for the following reasons:

1. The news item feature, attempted once before, had been discontinued because of lack of interest among those responsible for submitting the news. The editor has had a similar experience in connection with abstracting work. At one time there was a person at each experiment station charged with the responsibility of abstracting station publications of his own experiment station. This arrangement proved so unsatisfactory that finally it became necessary to adopt other means of securing abstracts.

2. If news items that are considered suitable by certain members of the organization were not regarded as of sufficient academic and general interest by the editor to warrant publication, embarrassment or friction might result.

3. A majority of Journals somewhat similar in their field to that of the JOURNAL OF DAIRY SCIENCE in the dairy industry do not publish news notes. The strictly scientific journals seem to carry no news notes at all.

In view of the foregoing, the committee felt that it would not be wise to attempt a news feature at this time. However, should a strong demand for a news section arise among the membership at a later date, the matter can then be given further consideration.

Ten-Year Index. The Committee on Journal Management has given consideration to the advisability of publishing a 10-year index for the period ending in 1946, and would recommend to the Executive Board that immediate steps be taken toward the publication of a 10-year index of the JOURNAL OF DAIRY SCIENCE for the years 1937–46.

Replacements on Editorial Board. The Committee also recommends that the Editor give consideration to a revision of the list of Associate Editors in order to have a more representative group.

R. B. STOLTZ, T. S. SUTTON, FORDYCE ELY,
G. M. TROUT, A. A. BORLAND, *Chairman*

PRODUCTION SECTION

Secretary D. M. Seath, of the Production Section, presented the following report. He moved and Mr. M. O. Maughan seconded that the report be accepted. Motion carried.

This year's meetings of the Production Section were well attended. One joint symposium was held with the Extension Section on the general subject of "Mastitis and the Feed Situation" with special emphasis on their relationship to the war effort. On Tuesday and Wednesday papers relating to research problems in the various states were presented in two simultaneous sessions of the Section. Papers thus presented totaled 44.

Two business meetings were held. The following committee reports were presented.

The Report of the Dairy Cattle Breeding Committee was read and approved. During the past six years this Committee has spent considerable time in the preparation and revision of recommended procedures for the organization and operation of artificial breeding associations. It has also worked with the Purebred Dairy Cattle Association in evolving regulations for the safeguarding of registrations. These procedures and regulations are now contained in a mimeographed circular, which can be obtained from the Bureau of Dairy Industry.

The Dairy Cattle Breeding Committee also approved the inclusion of type rating in conjunction with the reporting of lactation records in the proving of bulls and urges that more attention be given to this phase of the herd improvement program. In view of the present feed situation the committee also urged that the stringent culling of low-producing cows be again emphasized.

The report of the Breeds Relation Committee was read and accepted. In this report were several suggested changes regarding the conduct of Herd Improvement Registry and Advanced Registry tests. Some of these suggestions aim to eliminate conditions arising from the present emergency.

During the coming year a representative of this Committee will serve on a committee of the Purebred Dairy Cattle Assocation to "write one set of uniform rules" for the testing of all breeds and to study the possibility of improving the testing program.

The Breeds Relation Committee will continue to arrange for the printing and distribution of uniform official testing forms.

Report of the Feed and Pasture Investigations Committee recommended that a concerted effort be made to secure more and better pastures and high-grade roughage. Special emphasis was given to the need for pasture fertilization, and it was pointed out that larger quantities of nitrogen and phosphorus fertilizers are to be available this year. It was stated that there is a need for more information concerning effect of fertilization on palatability and the feeding value of pastures and forage crops. Recommendations were made that extension agencies stress pasture and forage crop production in an effort to produce a larger proportion of feed nutrients from roughage.

H. W. Cave, of Oklahoma, read a report submitted by the Committee on Animal Health of the National Research Council. This report was entitled "Adult Vaccination Against Brucellosis in Cattle." The report was accepted. The Production and Extension Sections asked that the Secretary of the American Dairy Science Association be requested to convey to the Committee on Animal Health of the National Research Council the appreciation of our Association for this progress report and urge the Committee on Animal Health to continue their study of this problem.

The Section voted to replace the feeds committee by creating a new one, called the Feeds Relations Committee, which will handle questions relative to concentrated feeds and especially those questions relating to the feed industry. Such a committee is to be a joint one with the Extension Section as soon as feasible. It was also voted to create a Herd Health Committee that will work jointly with a similar committee of the Extension Section.

The Resolution Committee reported no new resolutions, and that those of a general nature were being handled by Association's Resolution Committee for the general session.

The report of the Nominating Committee was approved and Dwight Seath, of Louisiana, was elected vice-chairman and George Wise, of South Carolina, as Secretary. Glenn Salisbury, of New York, the present vice-chairman, automatically becomes Chairman of the Production Section for this next year.

Respectfully submitted,
DWIGHT ESPE, *Chairman*
DWIGHT SEATH, *Secretary*

EXTENSION SECTION

Secretary W. T. Crandall reported the minutes of the Extension Section. He moved and Mr. Morley seconded that the report be accepted.

The Extension Section held all of its scheduled sessions with an attendance of over fifty members from 19 states. At the first session, Chairman Scheidenhelm announced the resignation of Gerald Heebink, of West Virginia, as Secretary of the Section and W. T. Crandall, of New York, was elected to fill the vacancy.

At the first sectional session problems involved in carrying on D.H.I.A. work were discussed by a four-member panel, the 4-H Club program was given, and a report of the 4-H Club adopted.

At the second session papers were given on the "Forced Ventilation System of Curing Hay in the Mow," "Getting Quality Bulls and Quality Semen," and "An Action Program for Rapid Washing Methods." Eighteen State exhibits on new Extension programs or successful methods of teaching were explained and discussed.

A report from the Resolutions Committee was read and adopted.

A joint symposium was held with the Production Session and presided over by Dwight Espe, of Iowa. The problems of Mastitis Control were discussed and a very comprehensive statement of the feed situation was made by Walter Berger, Chairman of the Feed and Livestock Division of the Food Production Administration.

At a joint business meeting of the Extension and Production Sessions reports of the following joint committees were read and adopted:

1. The Dairy Cattle Breeding Committee.

2. The Breed Relations Committee.
3. Pasture and Roughage Committee.

A report on "Adult Vaccination Against Brucellosis in Cattle" by the Committee on Animal Health of the National Research Council was read by H. W. Cave, of Oklahoma. This report was made to the American Dairy Science Association at the request of the 1943 Resolution Committee of the Association.

At its business session, the Extension Section listened to reports by the following committees:

1. Testing Committee.
2. Quality and Marketing Committee.
3. States with Exhibits and Committee on Teaching Ideas.
4. Type Rating Committee.
5. Dairy Cattle Health Committee.

All of these reports were adopted.

The final order of business was the election of E. H. Loveland, of Vermont, as the incoming Secretary for 1944–45. The chairman for the coming year is Floyd J. Arnold, of the University of Maryland.

Respectfully submitted,
W. T. CRANDALL, *Secretary*

MANUFACTURING SECTION

Secretary I. A. Gould then gave the following report for the Manufacturing Section. He moved and Mr. Seath seconded that it be adopted.

The programs for the Manufacturing Section were held during the afternoon of Tuesday, June 20, the morning of Wednesday, June 21, and the morning of Thursday, June 22, with P. F. Sharp as general chairman. Thirty-eight titles were accepted for the program, and only four of the papers (M7, M9, M26, M37) were not given. In addition to the regular papers, five additional papers were presented at the symposium dealing with Dehydrated Milk and Milk Products held the morning of Thursday, June 22.

The large number of papers submitted for the manufacturing program necessitated the scheduling of two sections, which met simultaneously. The various sectional programs were entitled Bacteriology, Chemistry, Butter and Cheese, and Milk and Milk Products.

The business meetings of the Manufacturing Section were held Wednesday and Thursday mornings. The Standing Committee reports were presented and accepted from the following committees:

(a) Committee for Milk and Cream—H. L. TEMPLETON, *Chairman.*
(b) Committee on the Judging of Dairy Products—G. M. TROUT, *Chairman.*
(c) Committee on Ice Cream—C. D. DAHLE, *Chairman.*
(d) Committee on Cheese—E. C. REICHERT, *Chairman.*

Committees on By-Products, Dried Milk, Evaporated Milk, Butter and Ice Cream presented no reports.

Discussions were held relative to man-power shortages, but no final definite action was taken.

The Resolutions Committee submitted no resolutions.

The Vice-Chairman for the past year, L. K. Crowe, of Nebraska, automatically becomes Chairman for the coming year. The two new officers elected were C. L. Hankinson, of Milwaukee, Wisconsin, Vice-Chairman, and N. S. Golding, Washington, Secretary.

Respectfully submitted,

I. A. GOULD, *Secretary*

NATIONAL RESEARCH COUNCIL REPORT

Mr. O. E. Reed, who represents this Association on the activities of the Division of Biology and Agriculture of the National Research Council, then told what the Council had been doing during the past year. He presented a list of the present committees, including those of the Food and Nutrition Board. A few of these special interests, which he singled out for individual mention, were

(1) The Committee on Milk of the Food and Nutrition Board.
(2) The Committee on Fats.
(3) The Committee on Dietary Allowances.
(4) The Committee on Animal Nutrition.
(5) The Committee on Animal Health.
(6) The Committee on Food Composition.
(7) The Food and Nutrition Board.

The report listed the organization of the Division and the basic organization of the National Research Council.

Mr. Glenn Salisbury moved and Mr. Sutton seconded that the report be accepted.

TRAINING AND EMPLOYMENT OF MILK SANITARIANS

P. H. Tracy then presented a report on "Training and Employment of Milk Sanitarians," which appears on pages 691–700 of this issue.

Tracy moved and A. A. Borland seconded that the report be adopted.

NECROLOGY COMMITTEE

Mr. N. N. Allen of Vermont read the report of the Committee on Necrology as follows:

The Necrology Committee reports the following members as having passed away during the year:

Professor A. C. Anderson passed away on January 13, 1944. Born in New York he graduated from Michigan State College in 1906. He was head

of the Dairy Department of that institution from 1910–1923 when he joined the staff of the Michigan Milk Producers' Association from which he retired in 1940. Professor Anderson was vice-president of the American Dairy Science Association in 1916 and president in 1917, to which Association and the dairy industry he contributed much.

Doctor M. J. Doreas of Berea, Ohio, widely known for his contributions in the field of science, passed away August 11, 1943. Born in Iowa, he was graduated from Baker University and received his Ph.D. degree from Harvard, following which he taught chemistry at Wesleyan University, in Connecticut, and conducted research at the Bermuda Station of the Rockefeller Institute for Biological Research. In 1925 he entered the Research Laboratories of the National Carbon Company, Cleveland. In later years his efforts were devoted largely to special applications of carbon and graphite products in the chemical and metallurgical industries and to the supervision of construction of synthetic rubber plants.

Edwin A. Hanson, Assistant Professor and Extension Dairyman at the University of Minnesota, passed away on April 13, 1944. Widely known among dairymen of Minnesota and adjoining states, he pioneered in the organization of cow testing and dairy herd improvement associations, took an important part in teaching dairy improvement to 4–H members and was one of the authors of "Feeding the Dairy Herd," a widely used handbook of dairy management in his state. He became Extension Dairyman in 1922.

Doctor Leroy S. Palmer, eminent dairy scientist and Chief in the Division of Agricultural Biochemistry of the Department of Agriculture of the University of Minnesota, passed away on March 8, 1944. Born in Illinois he received his B.S., M.S., and Ph.D. degrees from the University of Missouri where he served on the teaching and research staff from 1911 to 1919, when he went to the University of Minnesota. During more than 30 years of research and teaching he earned world-wide recognition as a chemist, especially in dairy science and nutrition, his principal interests being in such fields as the pigments of milk and butter, cause of butter defects and storage troubles, the physical and colloidal chemistry of milk and the churning process. Dr. Palmer was the first recipient of the Borden Award for outstanding research in the chemistry of milk.

Doctor Elmer S. Savage, professor of Animal Husbandry at the New York State College of Agriculture, passed away on November 22, 1943. He was born in New Hampshire and received his B.S. degree from the University of New Hampshire and his M.S. and Ph.D. degrees from Cornell University with which he has been associated since 1909. Maintaining outstanding leadership in the field of feeding and management of dairy cattle, he was an ardent exponent of "open formula" feeds and contributed much to the development of more economic methods of raising dairy calves through the use of whole milk substitutes. Professor Savage has served as secretary and vice-president of the American Society of Animal Production.

The Committee has just learned that Keith Thorneloe of the Comico Products Corporation passed away in October, 1943, and Mr. O. G. Simpson of Portland, Oregon, passed away in February, 1944.

Mr. N. N. Allen moved and Mr. K. G. Weckel seconded that the report be accepted.

RESOLUTIONS COMMITTEE REPORT

Mr. Fordyce Ely, Chairman of the Resolutions Committee, submitted the following report:

WHEREAS: The Borden Company has again seen fit to offer their awards for outstanding research in dairy production and dairy manufacturing,

Therefore, be is *Resolved:* That the American Dairy Science Association express to them our sincere appreciation of this evidence of their great interest in research, which is so vital a part of our industry.

WHEREAS: The Committtee on Animal Health of the National Research Council has presented a report dealing with the problem of Brucellosis vaccination in cattle,

Therefore, be it *Resolved:* That the American Dairy Science Association express its appreciation for the information furnished in said report.

WHEREAS: The Committee on Animal Health of the National Research Council has presented a report entitled "Adult Vaccination against Brucellosis in Cattle—A Report to the American Dairy Science Association,"

Therefore, be it *Resolved:* That the American Dairy Science Association request the same committee to prepare a parallel report dealing with the public health aspects of Brucellosis.

WHEREAS: There exists a lack of uniformity between States in the interpretation and application of the calfhood vaccination plan for eliminating Brucellosis from herds and since this condition has caused a great deal of confusion and uncertainty,

Therefore, be it *Resolved:* That the representative of the American Dairy Science Association to the Inter-Association Council for Animal Disease and Production be instructed to call this matter to the attention of said Council and to encourage the adoption of uniform procedures.

WHEREAS: The inspection of milk and its products supplied to the Army is now vested in the veterinary corps of the Army Medical Department, thereby making it virtually impossible for college or university graduates in dairying, who are well qualified for milk inspection work to obtain commissions in this field,

Therefore, be it *Resolved:* That the American Dairy Science Association petition the proper Army authorities for a change in policy that will make it possible for the qualified dairy graduate to be commissioned to inspect milk and its products, thus making it possible for him to use his talents to the best of advantage in the armed forces.

WHEREAS: Ohio State University, through its administrative staff, its faculty, and especially its Dairy Technology and Dairy Husbandry staffs, have made available to the American Dairy Science Association in this its 39th Annual Meeting all needed physical equipment for the handling of the meetings, and

WHEREAS: In addition every possible personal courtesy has been extended to visiting members of the Association by members of the staff of the University, the staff of the Experiment Station, and local members of the dairy industry, and

WHEREAS: The efficient functioning of the groups mentioned is in a great measure responsible for a most successful and enjoyable meeting,

Therefore, be it *Resolved:* That the American Dairy Science Association take the occasion to officially express its thanks and appreciation and the President of the Association instructed to express this appreciation by letter to President H. L. Bevis and Dean J. F. Cunningham, of the College of Agriculture.

H. P. DAVIS, I. R. JONES, H. F. JUDKINS,
C. R. GEARHART, FORDYCE ELY, *Chairman*

Mr. Ely moved and Mr. Ragsdale seconded that the report be accepted.

REGISTRATION COMMITTEE REPORT

Mr. W. L. Slatter, Chairman of the Registration Committee, reported the registration of members as follows:

Ohio	78	New Jersey	8	West Virginia	3
Illinois	52	North Carolina	7	California	2
New York	36	Canada	5	Florida	2
Wisconsin	25	Nebraska	5	New Hampshire	2
Michigan	21	Texas	5	Washington	2
Washington, D. C.	16	Virginia	5	Arkansas	1
Pennsylvania	15	Kentucky	4	Delaware	1
Missouri	12	Oklahoma	4	Georgia	1
Minnesota	11	Tennessee	4	Kansas	1
Indiana	11	Vermont	4	Montana	1
Iowa	11	Connecticut	3	Nevada	1
Maryland	9	Louisiana	3	South Carolina	1
Massachusetts	8	Oregon	3	Maine	1

TOTAL REGISTRATION ..... 384 (38 States and Canada)
Members 324
Non-Members 60
Banquet Tickets 303

Upon motion duly seconded the report was accepted.

The Secretary-Treasurer then read the minutes of the meetings of the Executive Board which follow. He moved and Mr. Borland seconded that the minutes of the Executive Board be approved and that all actions taken

ARTHUR C. RAGSDALE, *President*

during the past year by the Executive Board be approved by this Association. The motion carried unanimously and the meeting adjourned.

INSTALLATION OF OFFICERS

At the annual banquet held at the Southern Hotel on Thursday evening, June 22, President A. C. Dahlberg installed the newly elected officers:

Mr. P. A. Downs of Nebraska and Mr. J. W. Linn of Kansas were installed as Directors for a period of three years in absentia. Mr. J. A. Nelson of Montana was installed as Vice-President and Mr. A. C. Ragsdale of Missouri was duly installed as President of the American Dairy Science Association before the assembly of 303 persons.

MEETING OF THE EXECUTIVE BOARD, AMERICAN DAIRY SCIENCE ASSOCIATION

R. B. STOLTZ, *Secretary-Treasurer*

Columbus, Ohio, 2:00 P.M., June 19, 1944

A meeting of the Executive Board of the American Dairy Science Association was held in Townshend Hall, Monday, June 19, 1944, at 2:00 P.M.

Present: President A. C. Dahlberg, Vice-President A. C. Ragsdale, Secretary-Treasurer R. B. Stoltz, Editor T. S. Sutton, Directors W. E. Petersen, G. M. Trout, R. B. Becker, C. L. Blackman, P. H. Tracy. Guests, E. S. Guthrie and H. F. Judkins. Absent: J. C. Knott and H. P. Davis.

Upon motion duly seconded the minutes of the last Annual Meeting were approved as published in the Proceedings.

Editor Sutton presented the Editor's report, and upon motion by Mr. Petersen and second by Mr. Trout it was accepted.

The Secretary-Treasurer's report was read, and upon motion by Mr. Trout and second by Mr. Tracy it was accepted.

The Auditing Committee's report was read, and upon motion by Mr. Tracy and second by Mr. Petersen, it was accepted and the committee discharged.

The budget for the year 1945, which had been prepared and mailed to the Directors a month previous, was approved on motion by Mr. Petersen and second by Mr. Tracy.

By ballot the Executive Board elected Mr. George Holm a member of the Journal Management Committee for a period of three years beginning at the end of this Annual Meeting.

Mr. Ragsdale moved and Mr. Tracy seconded that the three charter members, Mr. C. C. Hayden, Mr. E. S. Guthrie, and Mr. W. J. Fraser, who have maintained membership since the beginning of the organization be elected to honorary life membership. Mr. O. F. Hunziker, a fourth living charter member, was elected to honorary membership in 1942.

Mr. Trout moved and Mr. Blackman seconded that those men, who upon retirement, have been members of the American Dairy Science Association for a period of 25 years or more immediately before retirement, and who have notified the Secretary of their retirement and eligibility, shall become life members without paying dues upon action of the Board.

Mr. Trout moved and Mr. Blackman seconded that Dean Chris Larsen, Mr. E. G. Hastings and Mr. L. A. Rogers be made life members.

Mr. Petersen moved and Mr. Blackman seconded that the Editor and Secretary-Treasurer be elected annually by the Executive Board and be reelected annually as often as mutually agreeable. The term of office shall begin on January 1 following election. Mr. Ragsdale moved and Mr. Tracy seconded that Mr. Sutton be elected Editor. Mr. Blackman moved and Mr. Trout seconded that Mr. Stoltz be elected Secretary-Treasurer. Mr. Petersen moved and Mr. Trout seconded that the Executive Board express their appreciation to Mr. Sutton and Mr. Stoltz for their excellent services to our Association.

Adjournment.

Monday, June 19, 1944, 7:30 P.M.

Present: President Dahlberg, A. C. Ragsdale, T. S. Sutton, C. L. Blackman, R. B. Becker, W. E. Petersen, G. M. Trout, H. P. Davis, R. B. Stoltz. Guest: A. A. Borland. Absent: P. H. Tracy and J. C. Knott.

Mr. Becker moved and Mr. Petersen seconded that the American Dairy Science Association join the Inter-Association Council for Animal Disease and Production, that the Secretary be authorized to pay the dues, and the President appoint a representative from our organization for the ensuing year.

Mr. Davis moved and Mr. Petersen seconded that the action of the Board concerning the following that were taken by mail be validated:

(1) That $1800 be appropriated to reproduce 13 numbers of back Journals,

(2) That $2220 be invested in government bonds,

(3) That student affiliates, who have been in the armed service for several years, be given permission to become active members without paying the $5.00 initiation fee,

(4) That the Secretary be authorized to advertise and pay $300 for 100 copies of the 26th volume of the JOURNAL OF DAIRY SCIENCE.

It was moved by Mr. Davis and seconded by Mr. Petersen that in view of the suggestion from the National Research Council that the representative of the American Dairy Science Association be chosen from outside of the eastern states. The Board suggests that the President give consideration to the request.

Mr. A. A. Borland, of the Journal Management Committee, gave his report, and upon motion duly seconded it was approved.

Mr. Becker moved and Mr. Davis seconded that the invitation of Iowa State College to hold our annual meeting in 1945 be accepted, and that Wisconsin, Minnesota, Kentucky, and Illinois be thanked for their invitations.

Mr. Petersen moved and Mr. Trout seconded that the suggestion concerning "fellows" be referred to our committee on "Special Recognition" made up of our last three presidents to report at the next annual meeting.

Mr. H. P. Davis, Chairman of the General Program Committee, submitted a statement and recommendation.

After a long discussion, the Directors adjourned without action.

Tuesday, June 20, 1944, 6:00 P.M.

A meeting of the Executive Board of the American Dairy Science Association was held at the Faculty Club, Tuesday, June 20, 1944, at 6:00 P.M.

Present: President A. C. Dahlberg, Vice-President A. C. Ragsdale, Secretary-Treasurer R. B. Stoltz, Editor T. S. Sutton, Directors P. H. Tracy, C. L. Blackman, R. B. Becker, W. E. Petersen, G. M. Trout, H. P. Davis. Guest, H. F. Judkins. Absent: J. C. Knott.

Mr. Tracy moved and Mr. Petersen seconded that the minutes of the meetings held on June 19 be approved as corrected.

Mr. Becker moved and Mr. Trout seconded that the President be authorized to represent or appoint a representative to take part in inter-association or governmental activities which affect our industry or profession.

Mr. H. F. Judkins, Chairman of the Committee to Investigate the Training and Employment of Milk Sanitarians, appeared before the Executive Board and gave the report which appears on pages 691–700 of this issue.

Mr. Petersen moved and Mr. Blackman seconded that the report be accepted with thanks.

Mr. Stoltz moved and Mr. Trout seconded that the report be published in the JOURNAL OF DAIRY SCIENCE.

Mr. Petersen moved and Mr. Blackman seconded that a committee consisting of the President, Editor, and Secretary be appointed to negotiate, with power to act relative to the preparation of a 10-Year Index.

Mr. Petersen moved and Mr. Blackman seconded that the request of the Union of American Biological Societies be tabled.

The meeting then adjourned.

Wednesday, June 21, 1944, 6:00 P.M.

A meeting of the Executive Board of the American Dairy Science Association was held at the Faculty Club, Wednesday, June 21, 1944, at 6:00 P.M.

Present: President A. C. Dahlberg, Vice-President A. C. Ragsdale, Secretary-Treasurer R. B. Stoltz, Editor T. S. Sutton, Directors P. H. Tracy, C. L. Blackman, R. B. Becker, W. E. Petersen, G. M. Trout, H. P. Davis. Guest, J. A. Nelson. Absent: J. C. Knott.

Mr. Becker moved and Mr. Tracy seconded that the minutes of the Executive Board of June 20 be approved.

Mr. Tracy moved and Mr. Trout seconded that the Chairman of the Committee on post-war problems in dairy manufacturing and distribution be authorized to publish the report in trade papers and to mimeograph it for distribution.

Mr. Petersen moved and Mr. Ragsdale seconded that the Board go on record as commending the Ohio members for the splendid way in which they have handled the convention in every respect.

Mr. Davis moved and Mr. Becker seconded that it be the policy of the Board that the authorization of travel expense be limited to the President, Secretary, and Editor or their representatives. The motion carried not unanimously.

The meeting was then adjourned.

Thursday, June 22, 1944, 1:00 P.M.

A meeting of the Executive Board of the American Dairy Science Association was held in Campbell Hall, Thursday, June 22, 1944, at 1:00 P.M.

Present: President Dahlberg, Vice-President Ragsdale, Secretary R. B. Stoltz, Editor Sutton, Directors Blackman, Tracy, Becker, Davis. Guest, J. A. Nelson. Absent: Directors Petersen, Trout, and Knott.

Mr. Becker moved and Mr. Tracy seconded that the minutes of the Executive Board of June 21 be approved.

Mr. Becker moved and Mr. Blackman seconded that the budget be changed so that our Association could take care of travel expenses to Inter-Association affairs by our representatives that are appointed by the President. The budget, will, therefore, contain $100 for representatives' travel, and the emergency fund will be reduced from $805 to $705.

The meeting then adjourned.

AMERICAN DAIRY SCIENCE ASSOCIATION PRESENTED BORDEN AWARDS TO P. H. PHILLIPS AND A. C. DAHLBERG

Columbus, Ohio, June 22, 1944

Mr. C. C. Hayden, of the Ohio Agricultural Experiment Station of Wooster, a charter member of the American Dairy Science Association was toastmaster at the annual Association banquet, and presented Mr. W. E. Krauss, Chairman of the Dairy Production Borden Award Committee, who made the following statement:

"The Dairy Production Award Committee, after careful consideration of the accomplishments of a long list of worthy candidates, has unanimously

selected as the winner of the Borden Award in Dairy Production Dr. Paul H. Phillips of the University of Wisconsin.

"During the period 1939 through 1943 Dr. Phillips has been senior author or co-author of 38 scientific articles, 23 of which have been directly concerned with dairy production problems or fundamental studies leading to their solution. Most of this work while involving the application of biochemistry, histology, and pathology to fundamental science, has nevertheless had wide practical application and has aided materially in answering questions of fundamental economic importance in the field of dairy production.

"The results of his fluorine studies with dairy cattle, where different levels of this element were fed, have served as a guide in formulating our present recommendations regarding the tolerable limits of fluorine in dairy rations. At a time when the common low-fluorine phosphorus supplement, bone meal, is short in supply and there is a tendency to introduce various types of high fluorine phosphates, the work of Dr. Phillips assumes current as well as fundamental significance.

"The greatest contribution made by Dr. Phillips to the field of dairy production, and perhaps the greatest contribution to the livestock industry during the past decade, has been the series of studies concerned with reproduction. These have led to the discovery and widespread adoption of a sperm-preservation technique and a promising treatment for maintaining fertility in both bulls and cows. The far-reaching effects of the egg-yolk-buffer diluent for spermatozoa and the ascorbic acid treatment of sterility are perhaps most appreciated at the present time in artificial breeding associations, but their value filters down even to the individual farmer. Although these original techniques eventually may yield to modified or improved procedures they nevertheless constitute an important milestone in the development of dairy cattle breeding.

"Another series of scientific achievement, in which Dr. Phillips was the prime mover, is that concerned with the nutrition of the young calf. The interrelationships between vitamin A, carotene, ascorbic acid and factors of the B-complex, and the possible role of these factors in reducing calf diseases and mortality, constitute basic information which opens the door to new achievements in a much-neglected field.

"At a time like this there probably is sufficient interest in the background of a man who is recognized publicly as a scientist to warrant a brief biographical sketch. Dr. Phillips was born in Illinois but really grew up on a ranch in Wyoming and received his early schooling there. After graduating from Washington State College in 1923 he spent several years in Russia, where, among other duties, he was assistant director of the Agricultural School in the Caucasus operated by the Near East Relief Foundation. Dr. Phillips entered the graduate school of the University of Wisconsin in 1929

DR. PAUL H. PHILLIPS

DR. ARTHUR C. DAHLBERG

and received the degree of Doctor of Philosophy from that institution in 1933. He now holds a full professorship in the Department of Biochemistry.

"An animal husbandman at heart, a biochemist by training, and at present a dairyman after hours, Dr. Phillips has combined fortunate traits of character, training and experience in doggedly achieving his present scientific status. A good teacher but a hard taskmaster, he has helped in the development of many students, and a corps of graduate students who have been associated with him in the work that was done and in the authorship of the papers that constituted the basis for the committee's selection."

Dr. Phillips came to the speakers' table and Mr. Wentworth of the Borden Company stated: "I really believe, Dr. Phillips, that that is the longest record of achievement I have ever heard in regard to any person chosen to receive this Award. I think you are to be congratulated upon it. I was also interested to note that the letter "W" is connected with your life—Wyoming, Washington, and Wisconsin. I don't know that it's anything significant, but I've lived under the letter "W" for a long time. However, it does give me a great deal of pleasure on behalf of the Borden Company to present the Borden Award, this medal that I trust you can keep forever, and $1000 as a partial measure of our appreciation for your achievements. I'm going to whisper this so that all can hear. You don't need to report this on your income tax."

Dr. Paul Sharp, Chairman of the Borden Award Committee for Manufacturing, was then introduced. Dr. Sharp then made the following statement:

"The recipient of the Borden Award in Dairy Manufacturing for this year received his Bachelor's and Master's degrees from the University of Minnesota and his Doctor's degree from Illinois. He is a practical dairy scientist who has made notable contributions to our knowledge of the viscosity of cream, cream whipping, the texture of ice cream, the use of gelatin in ice cream and water ices, the sweetness of sugars and their use in ice cream, studies on high-temperature short-time pasteurization, and a method for the manufacture of cream and Neufchatel cheese. He has also carried out investigations in the field of production such as the influence of the rate of milking upon yield and of the temperature on the filtering of milk.

"It was the unanimous opinion of the Borden Award Committee in Dairy Manufactures of the American Dairy Science Association that Dr. A. C. Dahlberg be selected for the 1944 research award in Dairy Manufactures.

"From 1921 to 1942 Dr. Dahlberg was Chief of Research in dairying at the New York Experiment Station in Geneva.

"Dr. Dahlberg has been active in association affairs as follows:

Editor of the JOURNAL OF DAIRY SCIENCE—1928 to 1938
Edited abstracts of the International Association of Ice Cream Manufacturers—1927 to 1937
Edited abtsarcts of the International Association of Milk Dealers—1930 to 1937
Delegate to the World's Dairy Congress at Berlin—1937
President of the New York Dairymen's Association—1926 to 1927
President of the New York Jersey Cattle Club—1926 to 1928
Now President of the American Dairy Science Association

"Mr. Wentworth, I am pleased to present to you Dr. Dahlberg the outgoing President of the American Dairy Science Association."

Mr. Wentworth then replied as follows:

"You remember that I received a letter last December from you suggesting that there be some changes in the rules under which this Award was given. That is a fact. One of the things which he undertook to do while President of this Association was to effect a change in the regulations of the management of this Association of these Awards. If he had been successful in making those changes, I would say that he had been a successful officer. But his success comes to him for other reasons as has been indicated by Dr. Sharp. Of course, Dr. Sharp lived up there is the State of New York for so long that he can just get up here and recite Dr. Dahlberg's accomplishments in contrast to Dr. Krauss reading Dr. Phillips' from a paper. Anyway, it's a great pleasure for me on behalf of the Borden Company to present to you this Award for 1944 in Dairy Manufacturing work; first, as usual, is the medal, and second is the check for $1,000."

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Vanilla Flavoring

A STUDY IN CLOSE TOLERANCES

In motors and machines we have come to marvel at the precision required to achieve the close tolerances of modern production. "One ten-thousandth of an inch" has ceased to be an unusual dimension. Today, industry works to fine measurements.

But to most laymen it would still be a surprise to learn that producing correct vanilla flavoring requires an equally keen appreciation of small fractions. With some of the flavoring constituents of the vanilla bean, "one ten-thousandth of an ounce" can be the deciding factor.

That is why the processing of vanilla flavoring requires such a thorough knowledge of the vanilla bean and its flavor factors. Dealing in such fractional percentages means that errors of judgment in the flavoring will be magnified in the finished ice cream. As the old Chinese proverb puts it so well, "An inch at the bow becomes a mile at the target."

For instance, the figures on ordinary vanilla extract illustrate the point. Of the thirteen and one-third ounces of vanilla beans used to make a gallon of extract, about one and a half ounces of vanilla bean solids get into the gallon of extract. Therefore, when four ounces of extract are used in five gallons of ice cream mix, the vanilla bean solids per gallon of ice cream amount to about five one-thousandths of an ounce—and the vanillin content to roughly one ten-thousandth of an ounce per gallon of ice cream.

Although vanillin is the chief flavoring constituent of vanilla, many other aromatics in the properly cured bean are present in even smaller amounts.

That is why such great care is taken in the production of Mixevan. That is why each bundle of selected beans is classified into one of the groups within groups, according to its flavoring characteristics. That is why blending of the different beans from different areas and added vanillin from tropical spices play such an important part in Mixevan production. That is why some of the undesirable fractions of the beans are removed during the processing. All this balancing and counter-balancing bring to each plate of vanilla ice cream the right amount of each and every flavoring constituent which combine to give it delicious mellow-mildness.

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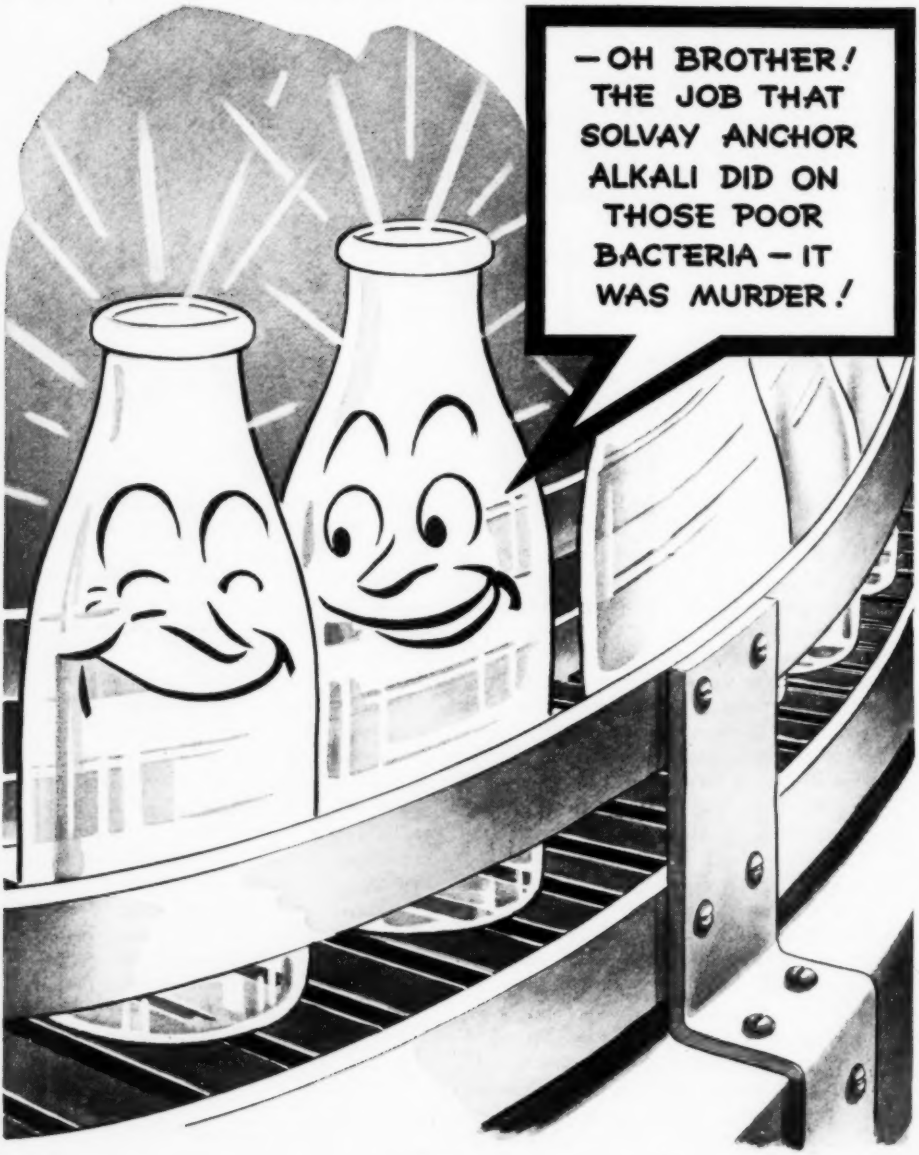

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The National Dairy Council program reaches every member of the family through the chief opinion-forming groups in all professional and educational fields. Such key groups as physicians, dentists, teachers, nurses, nutritionists, writers and public health workers are kept informed constantly of the dietary importance of all dairy products.

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Your advertisement is being read in every State and in 25 Foreign Countries

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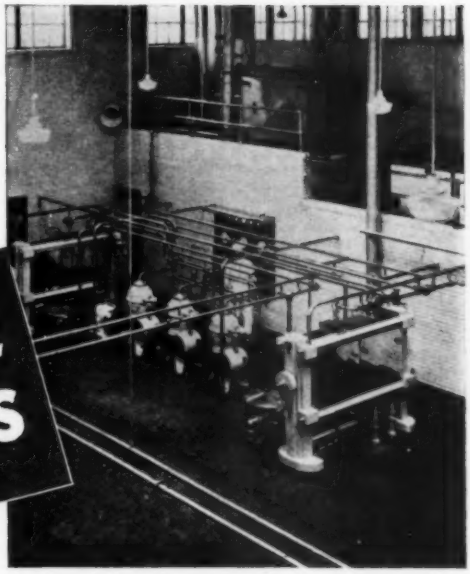
The American Dairy Science Association was organized to advance the general welfare of the dairy industry, especially by the improvement of dairy instruction by the stimulation of scientific research in all phases of the subject and by improvement in methods of conducting extension work.

Membership. Any person is eligible to membership who is formally announced by an Agricultural College or Experiment Station, or by the Bureau of Dairy Industry of the United States Department of Agriculture or by the Canadian Department of Agriculture as an instructor, extension worker, investigator, or administrative officer connected with the dairy industry, or any person filling a position of responsibility connected with the dairy industry who has had a college or university training in technical science, or any person filling a responsible position in the dairy industry of a professional character requiring a technical knowledge of dairying of a high order. The membership fee is $5.00.

The dues are $5.00 a year, $3.00 of which is for a year's subscription to the *Journal of Dairy Science*. Correspondence regarding membership and dues should be addressed to R. B. Stoltz, Ohio State University, Columbus, Ohio.

Your advertisement is being read in every State and in 25 Foreign Countries

At right . . . two standard SUPERPLATE SHORTIME PASTEURIZERS handling 28,000 lbs. of milk per hour in a large Illinois plant.



MULTIPLE SAVINGS

...orth

Superplate

SHORTIME PASTEURIZERS

Maximum economy and efficiency in pasteurizing milk, cream and milk products are important now. When you face post-war competition they will become *vital*. Plants which were new a few years ago, to say nothing of the older ones, will have to modernize their production methods and equipment to meet the new competition.

So today is a good day to call in your Cherry-Burrell representative and investigate the multiple savings you can make with a SUPERPLATE SHORTIME PASTEURIZER — savings in time, labor, product, floor space, equipment investment, maintenance, steam and refrigeration. Plus SUPERPLATE's flexibility as a single piece of equipment and a single equipment investment, to heat, regenerate, pasteurize and cool not only milk and cream but a wide range of other dairy products.

ASK FOR BULLETIN G-382R

CHERRY-BURRELL CORPORATION
427 WEST RANDOLPH STREET, CHICAGO 6, ILLINOIS

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FACTORIES, WAREHOUSES, BRANCHES, OFFICES OR DISTRIBUTORS AT YOUR SERVICE IN 85 CITIES

FOOD FIGHTS FOR FREEDOM

Your advertisement is being read in every State and in 25 Foreign Countries

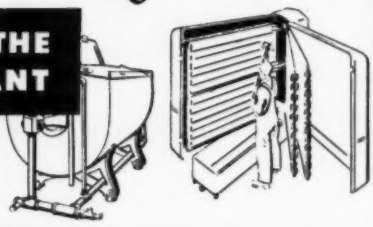
SANITATION TIPS

BY THE DIVERSEY D-MAN

HELPS CONTROL ROPY MILK

ON THE FARM

IN THE PLANT



WITH

DIVERSOL

Control and prevention of ropy milk begins on the dairy farm . . . likewise demands rigid measures of sanitation throughout the dairy plant. Both on the farm and in the dairy plant, Diversol, the quick-acting chlorine bactericide has proven most effective for all disinfecting operations.

Diversol comes in stable crystals that lock in the available chlorine until dissolved in water . . . thus assuring solutions of definite germicidal strength. Furthermore, Diversol's unusual penetrating power makes possible contact with bacteria. Harmless to all metal surfaces commonly used in dairy equipment . . . easy to use . . . leaves no film or scale. Write for technical bulletin "The Control and Prevention of Ropy Milk," **THE DIVERSEY CORPORATION, 53 W. Jackson Blvd., Chicago 4.**

Solve Scale Problems This SAFER Way!

More and more dairies, creameries, milk and ice cream plants are removing lime-scale from bottle and can washing machines with increased SAFETY! They are solving lime-scale problems with specialized

OAKITE COMPOUND No. 32

This quick-acting material is far SAFER to use and handle than commercial raw acids . . . helps avoid need for expensive, time-consuming mechanical methods for scale and rust removal. For FULL details send for NEW 28-page booklet. Write . . . TODAY!

OAKITE PRODUCTS, INC.,
Dairy Research Division,
16G THAMES STREET, NEW YORK 6, N. Y.
Technical Service Representatives Located in All Principal Cities of the United States and Canada

OAKITE Cleaning

FLAV-O-LAC FLAKES

THE CULTURE

of definitely better flavor & aroma-producing qualities.

The standard with foremost operators, agricultural schools & colleges.

FLAV-O-LAC FLAKES (shown) produce a quart of the finest starter on a single propagation. Single bottles $2.00.

SPECIAL FLAV-O-LAC FLAKES "40"

produce 40 quarts of starter on a single propagation. Single bottles $3.00

Free Culture Manual of Fermented Milk Products on request.

Pioneers in Spectro-chemical, Chemical and Fluoro-photometric Determinations of Vitamins A, B_1, B_2, Nicotinic Acid, Pantothenic Acid, B_6, C & E in Dairy and Food Products. (Vitamin D excluded) inquiries invited.

THE DAIRY LABORATORIES

DIVISION DALARE ASSOCIATES

23rd & Locust Sts., Phila., Pa.

BRANCHES

New York Baltimore Washington

See our catalog in Dairy Industries Catalog.

Your advertisement is being read in every State and in 25 Foreign Countries

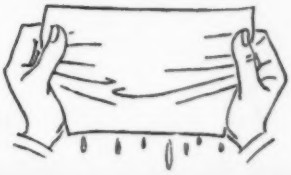
Double Purpose Paper

Imagine a paper that has such great wet-strength it can be soaked in water indefinitely — or boiled and remain firm and strong. Imagine the same paper with the ability to resist penetration of grease, fats, oil. Patapar* Vegetable Parchment is just such a paper. It has both qualities.

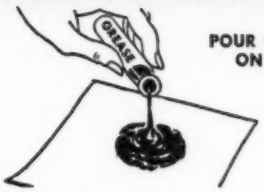
Strong when wet

BOIL IT IN WATER—

COMES OUT STRONG AND FIRM



Resists grease, too



POUR GREASE ON IT—

RESISTS PENETRATION

With this great wet-strength and ability to resist grease, Patapar is solving many of today's difficult problems of packaging and protection. It is ideal for

BUTTER WRAPPERS
TUB LINERS AND CIRCLES
PRINTER BOX LINERS
BULK CORRUGATED BOX LINERS
MILK CAN GASKETS
MILK BOTTLE HOODS
CHEESE WRAPPERS AND LINERS
ICE CREAM FLAVOR LABELS

*Reg. U.S. Pat. Off.

And many other uses

Patapar *Vegetable Parchment*

Paterson Parchment Paper Company • Bristol, Pennsylvania

WEST COAST PLANT: 340 BRYANT STREET, SAN FRANCISCO 7, CALIFORNIA
BRANCH OFFICES: 120 BROADWAY, NEW YORK 5, N. Y. • 111 WEST WASHINGTON STREET, CHICAGO 2, ILL.

Headquarters for Vegetable Parchment since 1885

Your advertisement is being read in every State and in 25 Foreign Countries

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The Board of Directors has recently had nine back numbers reproduced

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Vol. XI	5.00	Vol. XXIII	6.00
Vol. XII	5.00	Vol. XXIV	6.00

Individual numbers $1.00 each

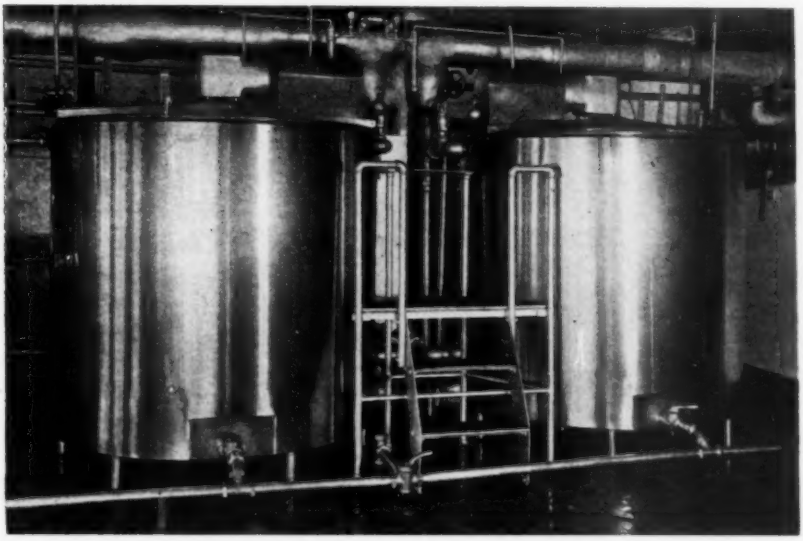
These may be procured by ordering them from the Sec'y-Treas., c/o Ohio State University, Columbus, Ohio. Make all checks payable to the

AMERICAN
DAIRY SCIENCE ASSOCIATION

Your advertisement is being read in every State and in 25 Foreign Countries

WORLD'S No. 1 VAT

. . . for finest butter flavor and quality



Creameries using the Mojonnier Stainless Steel Cream Vat acclaim it the most outstanding unit on the market. Here are a few reasons why:

1. Its ability to maintain perfect temperature control in *heating, holding* and *cooling*—a most important factor in the obtaining of a fine butter flavor.

2. All operations can be performed in *one* unit—receiving the cream, following through with the exacting steps necessary to the production of a quality butter, to storing the cream for the churn. Thus, only *one* stickage loss.

3. Cleaning is surprisingly simple as there are no stuffing boxes and the interior is free from coils—just a one-piece, all-welded and polished mirror-like stainless steel cup that cleans quickly and easily.

4. Its single shell (not insulated) cover, which eliminates all of the hazards of a heavy cover while at same time providing even temperature holding.

5. And *efficiency*—users say without exception, "it's the quickest by far for heating and cooling."

All told, the many exclusive advantages of this Stainless Steel Vat make it well worth investigating for your operation. Write us today for complete details.

MOJONNIER BROS. CO. 4601 W. OHIO STREET CHICAGO 44, ILLINOIS

Mojonnier CREAM VAT

Your advertisement is being read in every State and in 25 Foreign Countries

OUR SALT carries an umbrella!

Know why an Englishman carries an umbrella? To *keep dry*, of course . . . and we've developed a practical "umbrella" for Diamond Crystal Salt —to help keep it dry and prevent caking.

Salt cakes, owing to excessive humidity, because moisture condenses on salt particles, forming a thin layer of brine. In dry weather, the brine evaporates and the crystals knit together.

Our research laboratory has found a number of ways to help prevent salt caking. Removing moisture-attracting impurities, such as calcium chloride, helps. So does complete removal of fines by careful screening. Most important is to provide salt with a moisture-vapor-resistant package to keep out dampness.

Take our Flour Salt bag: It is composed of three 50-lb. sheets of kraft and two 25-lb. sheets of kraft, laminated with 40 lbs. of asphalt per ream. That's a lot of asphalt, and it costs us more money—but our moisture-vapor transmission tests show that this bag is worth the extra cost. The bag is even sewn with *waxed thread* to seal up holes made by the sewing-machine needle. That's *real protection*—one reason we have been able to eliminate caking as a major problem!

NEED HELP? HERE IT IS! If *you* have a salt problem, write our Director of Technical Service. He will be happy to help! Diamond Crystal Salt, Dept. H-1, St. Clair, Michigan.

DIAMOND CRYSTAL SALT
ALBERGER PROCESS

"HANSEN'S"
Dairy Preparations

Cheese Rennet and Color
Annatto Butter Color
Certified Butter Color
Ice Cream Color
Lactic Ferment Culture
Bulgarian Culture

—★—

Cheese Bandages, Circles
Press Cloths
Odorless Dairy Fly Spray
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Rennet Tests

CHR. HANSEN'S LABORATORY, INC.
MILWAUKEE, WISCONSIN

Marschall
RENNET and COLOR

For best results in the cheese vat, specify Marschall's. High in strength, pure and uniform.

MARSCHALL
DAIRY LABORATORY, INC.
MADISON 3, WISCONSIN

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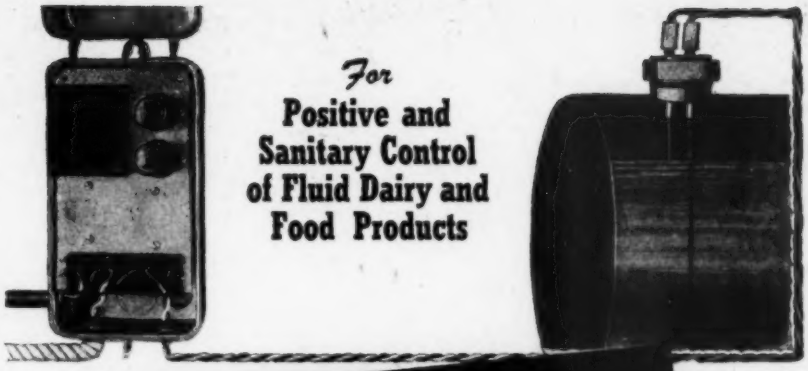


For
Positive and Sanitary Control of Fluid Dairy and Food Products

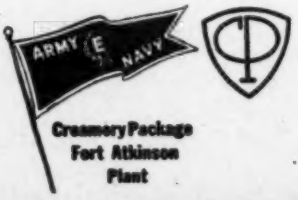
LACTRON
Liquid Level Controls

• Here's the solution to one of the Dairy Industry's most troublesome problems. The LACTRON Liquid Level Control —utilizing the modern principle of electronics—provides a dependable, sanitary means for *measuring* and *controlling* the volume of any fluid dairy product. Quickly and easily installed in pasteurizers, storage tanks, receiving tanks, vacuum pans, cooler troughs, etc.

The LACTRON Liquid Level Control is remarkably efficient and completely sanitary. It eliminates the need for floats and other hard to clean moving parts. The only part of the LACTRON Control in contact with the liquid product is a stainless steel rod electrode. In operation, the unit is accurate to 1/1000 of an inch—regardless of the speed of change in the level of the product. Neither pressure, nor freezing or boiling temperatures affect the action.

Illustration shows a two-level LACTRON Control. By means of additional electrodes and corresponding electronic tubes, as many as five levels can be controlled. Special accessories are available for fully automatic control of pumps, motors and other moving equipment.

Experience in scores of dairy products plants shows that LACTRON Control pays for itself in a short time by eliminating loss from spillover. Write for Bulletin No. *H*-792.



Creamery Package
Fort Atkinson
Plant

THE CREAMERY PACKAGE MFG. CO.
1243 W. Washington Blvd., Chicago 7, Illinois

Branches: Atlanta — Boston — Buffalo — Chicago — Dallas — Denver — Kansas City — Los Angeles — Minneapolis — New York — Omaha — Philadelphia — Portland, Oregon — Salt Lake City — San Francisco — Seattle — Toledo — Waterloo, Iowa

CREAMERY PACKAGE MFG. CO. OF CANADA, LTD.
267 King St., West, Toronto 2, Ont., Canada

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DIFCO

CULTURE MEDIA
for Examination of Milk

Bacto-Tryptone Glucose Extract Agar

is recommended for use in determining the total bacterial plate count of milk in accordance with the procedures of "Standard Methods for the Examination of Dairy Products" of the American Public Health Association.

Upon plates of medium prepared from Bacto-Tryptone Glucose Extract Agar colonies of the bacteria occurring in milk are larger and more representative than those on media previously used for milk counts.

Bacto-Proteose Tryptone Agar

is recommended for use in determining the bacterial plate count of Certified Milk. The formula for this medium corresponds with that suggested in "Methods and Standards of Certified Milk" of the American Association of Medical Milk Commissions.

Bacto-Violet Red Bile Agar

is widely used for direct plate counts of coliform bacteria. Upon plates of this medium accurate counts of these organisms are readily obtained.

Bacto-Brilliant Green Bile 2% and
Bacto-Formate Ricinoleate Broth

are very useful liquid media for detection of coliform bacteria in milk. Use of these media is approved in "Standard Methods."

Specify "DIFCO"
THE TRADE NAME OF THE PIONEERS
In the Research and Development of Bacto-Peptone and Dehydrated Culture Media.

DIFCO LABORATORIES
INCORPORATED
DETROIT, MICHIGAN

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